LAC MINERALS LTD.

Open File Report 91-4

EXTENSION OF THE MOUNT PLEASANT TIN DEPOSIT

CHARLOTTE COUNTY, NEW BRUNSWICK

(PART I)

by

LAC Minerals Limited

Canada-New Brunswick Mineral Development Agreement

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(PART I)

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Project Summary

Three deep diamond drill holes (LNZ 13, 14, and 18) were drilled 0.7 km and 0.8 km east and 1 km northeast of the tin bearing North Zone at Mount Pleasant. (Fig. 1)

Total meterage drilled was 1602.0 m.

The main objective of the drilling was to investigate radiometric and IP anomalies which could be associated with significant tin deposits.

All three holes intersected pervasively altered porphyries and granites with varying amounts of sulphide minerals (mainly sphalerite, galena, arsenopyrite, molybdenite) and oxide minerals (wolframite and cassiterite). IP and radiometric anomalies are explained by high level of sulphides and associated radioactive minerals.

Some significant zinc mineralization was encountered. The best intersection obtained was in hole LNZ 13 with 6.49% Zn, 0.29% Sn and 9.55 g/t Ag over 6.1 m. The intersection is from 274.3 to 280.4 m below collar. However, no significant tin deposits were found that could have an immediate impact on the viability of the tin deposits of the North Zone.

Two holes, LNZ 13 and LNZ 18, bottomed in a fine grained porphyritic granite which appears identical to Granite III, the youngest of three geochemically highly specialized tin granites of the North Zone. Granite III has also been intersected in a deep hole below the tungsten bearing Fire Tower Zone.

From the results obtained it is evident that tin bearing granites have a much larger areal extent at Mount Pleasant than expected. Granite III probably extends over several km^2 and could extend well into the Mount Pleasant Caldera.

The third hole, LNZ 14, intersected feldspar porphyry and its intrusive equivalent, the McDougall Brook Porphyritic Microgranite, an older, less specialized granite. Levels of mineralization were generally lower than in LNZ 13 and 18. No attempt was made to establish the presence of Granite III in LNZ 14. Granite III may also be underlying this area but probably at considerable depth.

Sommaire du projet

Trois trous profonds de forage au diamant (LNZ 13, 14 et 18) ont été forés 0,7 km et 0,8 km à l'est et 1 km au nord-est de la zone stannifère septentrionale du Mount Pleasant (figure 1).

La longueur totale forée fut de 1 602 m.

L'objectif principal du forage était de vérifier les anomalies radiométriques et de polarisation provoquée qui pourraient être associées à des gîtes d'étain.

Les trois trous ont recoupé des porphyres complètement altérés et des granites contenant des quantités variables de minéraux sulfurés (principalement de la sphalérite, de l'arsénopyrite et de la molybdénite) et des minéraux d'oxydes (wolframite et cassitérite). Les anomalies PP et radiométriques sont expliquées par un haut niveau de sulfures et des minéraux radioactifs associés.

Une minéralisation importante en zinc a été observée. La meilleure intersection provient du trou LNZ 13 avec 6,49 % de zinc, 0,29 % d'étain et 9,55 g Ag/tonne sur 6,1 m. L'intersection se retrouve entre 274,3 et 280,4 m sous le collet. Toutefois, aucun dépôt d'étain n'a été identifié qui pourrait avoir un impact immédiat sur la viabilité du gisement de la zone nord.

Deux trous, LNZ 13 et 18, se sont terminés dans un granite porphyritique à grain fin qui semble identique au granite III, le plus jeune de trois granites stannifères géochimiquement très spécialisés situés dans la zone nord. Le granite III a aussi été recoupé dans un trou profond sous la zone stannifère de Fire Tower.

À partir des résultats obtenus il est évident que les granites stannifères de Mount Pleasant ont une étendue beaucoup plus grande que prévue. Le granite III se retrouve probablement sur plusieurs km^2 et pourrait se prolonger bien à l'intérieur du caldéira du Mount Pleasant.

Le troisième trou, LNZ 14, a recoupé un porphyre feldspathique et son équivalence intrusive, le microgranite porphyritique de McDougall Brook, un granite plus vieux et moins spécialisé. La minéralisation était généralement plus faible que pour LNZ 13 et 18. Rien n'a été fait pour établir la présence de granite III dans LNZ 14. Un granite III pourrait aussi se retrouver sous cette zone mais à une très grande profondeur.

Acknowledgements

The project was undertaken by Lac Minerals Ltd. with a $50,000 contribution of the Mineral Investment Stimulation Program (MISP). The work was carried out on Billiton Metals Canada Inc.'s Mining Licence 1255.

1.0 Introduction

1.1 Objective:

The objective of the project was to evaluate the Mount Pleasant Mining Licence outside the well explored North Zone and Fire Tower Zone for the presence of tin mineralization.

An area east and north-east of the North Zone was selected based on the presence of radiometric and/or IP anomalies.

1.2 Scope:

Deep vertical diamond drilling was considered the most effective method of exploring.

Three holes were collared on the most promising radiometric and/or IP anomalies.

The first hole drilled, LNZ 13, was sited on a radiometric anomaly with a coinciding IP anomaly. The anomaly was previously explored by shallow drilling (up to 150 m depth) in 1970. This drilling revealed the presence of tin-base metal veining with up to 0.5% Sn over narrow widths. The second hole, LNZ 14, was drilled on a radiometric anomaly, initially found during a scintillometer survey carried out by Billiton Canada Ltd. in 1978. The same anomaly was one of the better anomalies encountered by an airborne radiometric survey conducted by the Geological Survey of Canada in 1987 over parts of the Mount Pleasant Caldera.

Ground follow-up by the GSC located the source of the anomaly. LNZ 14 was collared in the immediate vicinity of a black fluorite-pyrite-chalcopyrite-arsenopyrite vein which carries an estimated 300 ppm U_3O_8. The third and last hole of the program, LNZ 18, was collared on the best IP anomaly of a 50 km IP survey conducted over the NE quadrant of the Mining Licence by Lac Minerals Ltd. during the summer of 1988.

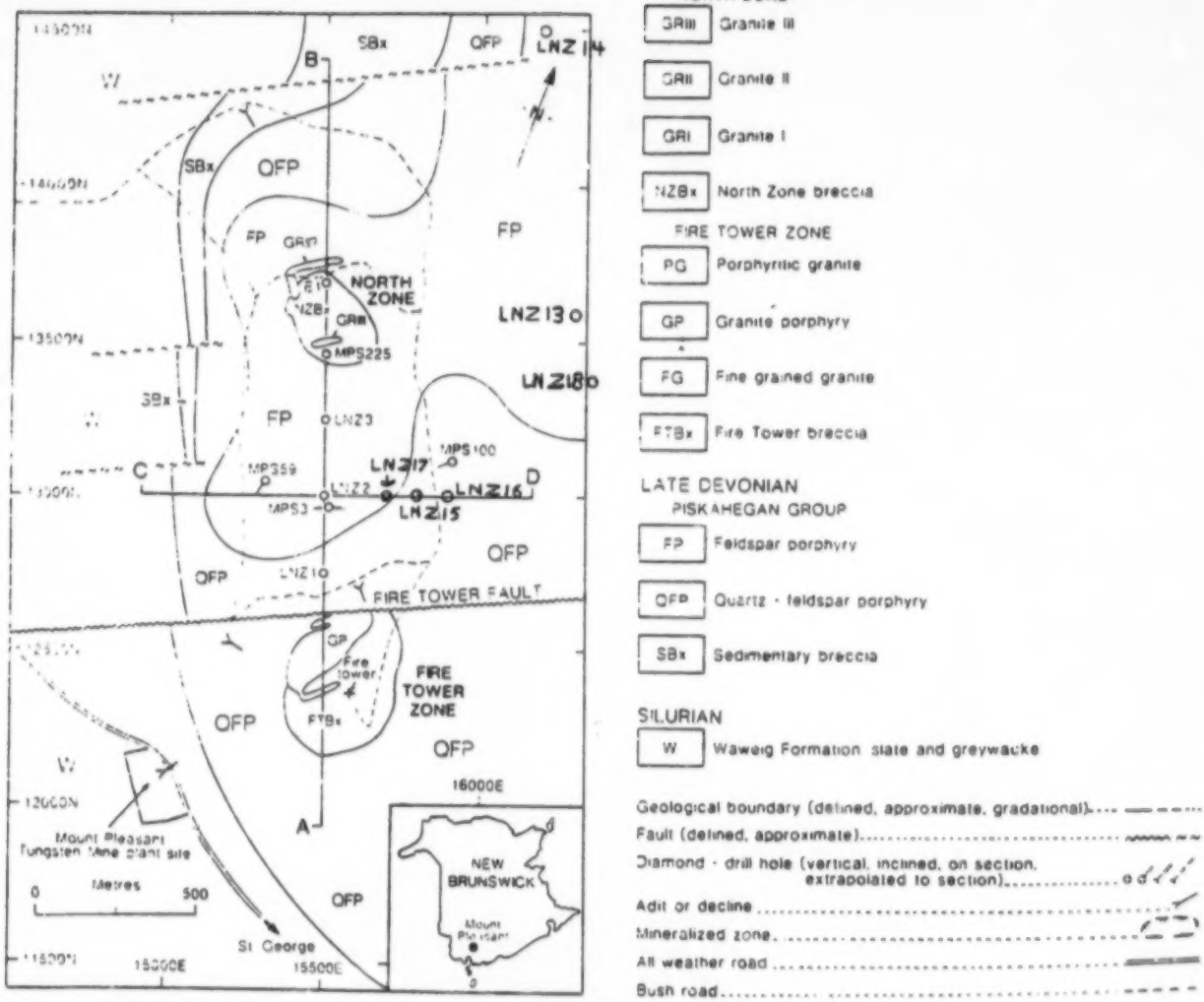
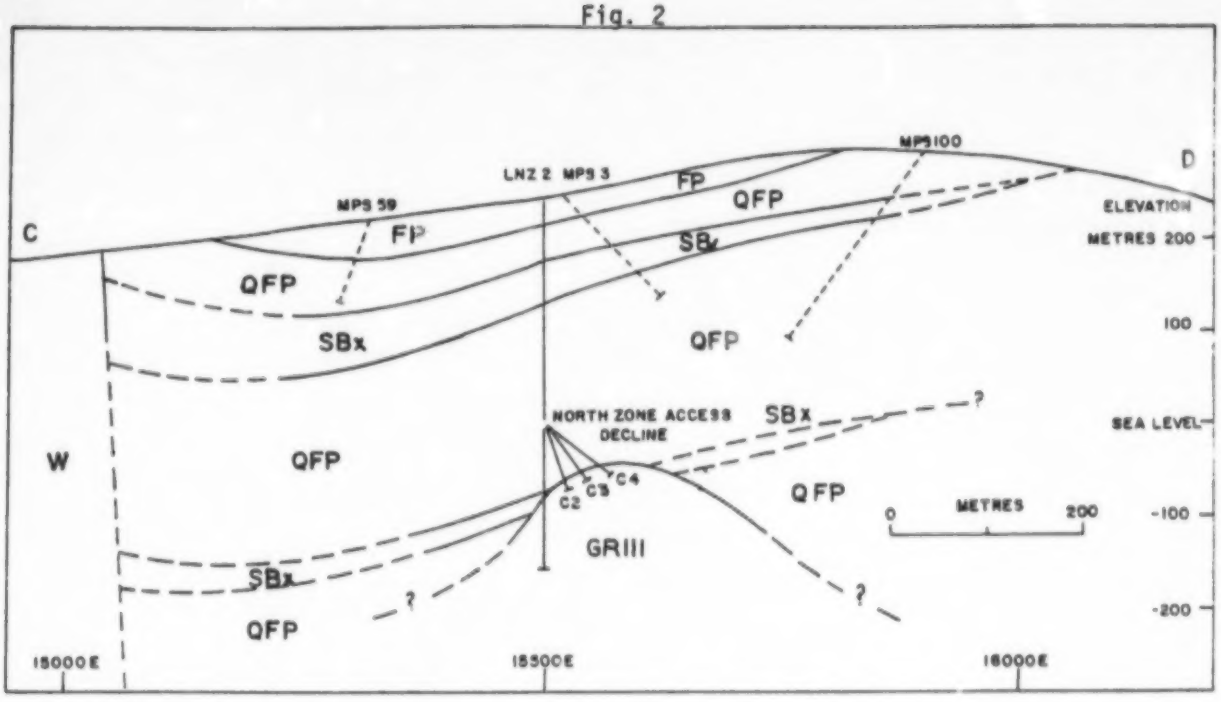
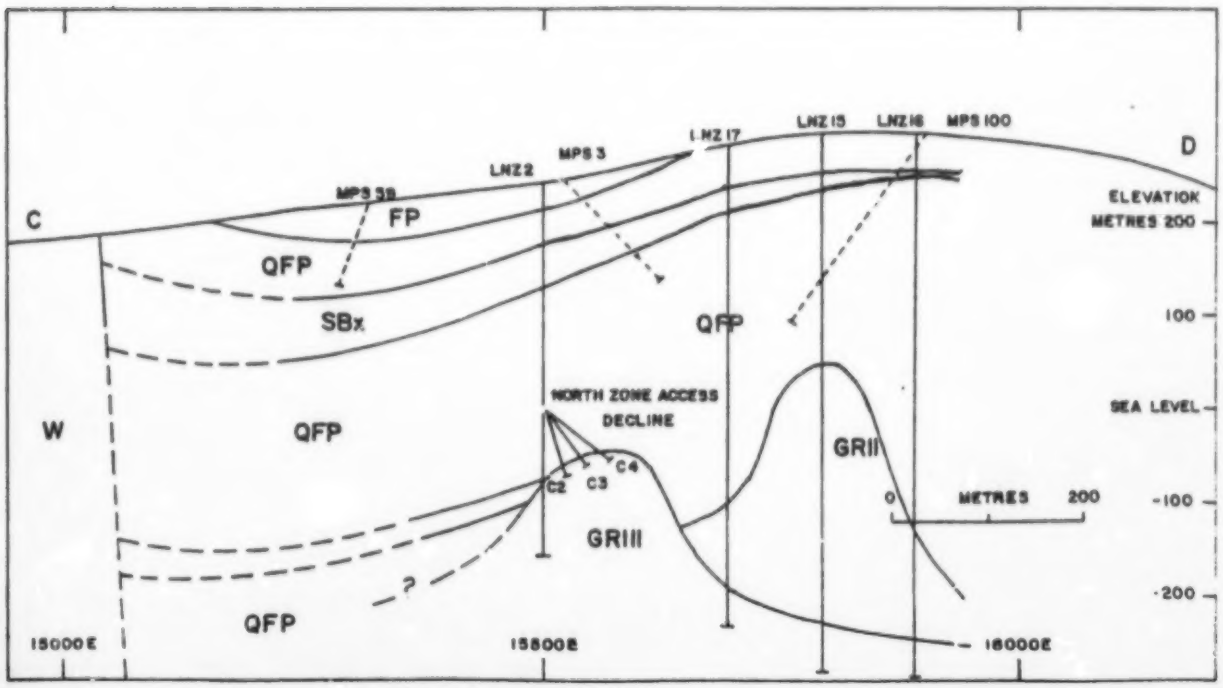


Figure 1. Surface geological map of the Mount Pleasant area (modified from Ruitenberg, 1967 and McCutcheon, 1983). Showing location of LNZ holes.

Fig. 2



Section 13000 through Saddle Area (prior to 1988 drilling)



Section 13000 through Saddle Area

1.3 Background:

A recent paper by Sinclair et al (1988) is attached as Appendix 1. The paper is a summary of the geological work carried out during 1985 - 1987 on the Lac-Billiton tin project.

2.0 Project Methodology

All cores were logged for rock types, alteration styles, mineralization and RQD (Rock Quality Designation). Selected cores were split and assayed in standard 10 foot lengths. Analytical results were routinely obtained for Wo_3, MoS_2, As, Cu, Bi, Pb, Zn, Sn and Fe. Assaying was carried out at site by well established XRF methods. Check assays and silver assays were carried out by Lakefield Research of Lakefield, Ontario. All core of LNZ 13 was split and analyzed (193 samples), no core of LNZ 18 was assayed and ten samples were submitted from LNZ 14.

3.0 Results and Discussion

3.1 Presentation of Results

Diamond drill hole summaries for LNZ 13, 14 and 18 are presented as Table I-III.

Individual analytical results are tabulated in Tables IV and V. PC Explorer printouts of individual holes are attached as Appendix 2 and 3.

3.2 Discussion

A number of tin bearing zones were intersected in LNZ-13. However, tin content is low (max. 0.39% Sn) and most zones are narrow (3-6 m) compared to the tin deposits of the North Zone. A significant zinc intersection was obtained in LNZ 13, returning 6.49% Zn, 0.29% Sn and 9.55 g/t Ag over 6.1 m. LNZ 18 is similar in rock types, style and intensity of alteration and mineralization to LNZ 13.

Metal values in LNZ 14 are generally lower than in LNZ 13 and 18. Max. tin value obtained in LNZ 14 is 0.12% Sn over 8.1 m

4.0 Conclusion and Recommendations

The surprisingly high degree of alteration in all rock types in LNZ 13 and 18 indicates that this area is still part of the huge (several km^2) Mount Pleasant hydrothermal system. It is therefore prospective ground for future exploration.

However, this area has a lower priority for further work than the Saddle Area (Ref. Project 8714-21 G7).

5.0 References

Sinclair, W.D., Kooiman, G.J.A. and Martin, D.A., 1988, Geological setting of granites and related tin deposits in the North Zone, Mount Pleasant, New Brunswick; in Current Research, Part B, Geological Survey of Canada, Paper 88-1B, p. 201-208.

Table I

DIAMOND DRILL HOLE SUMMARY

HOLE NO: LNZ-13 COORDINATES: 13,600 N 16,320 E COLLAR ELEVATION: 1,216 m

DATE STARTED: 14/06/88 HOLE SIZE: NQ 3.66-150.87 m BQ 150.87-587.32 m CASING: 3.66 m

DATE COMPLETED: 13/07/88

SURVEYS:

Depth	365.74	457.18	587.32			
Bearing	N 284.5°	N 300.5°	N 300°			
Dip	-89°	-87°	-88°			

Description	Log	Depth (m)	Intersection
Feldspar Porphyry: Mixed siliceous, chloritic and brecciated feldspar porphyry. Pyrite, sphalerite, arsenopyrite, galena and chalcopyrite in veining and in altered feldspar porphyry. Tin mineralization in veining and in one breccia dyke. Local porphyritic granite dykes.		100	1 2
Quartz-Feldspar Porphyry: Mixed stockwork, siliceous, chloritic and brecciated quartz-feldspar porphyry. Minor yellowish-green "fresh" quartz-feldspar porphyry. Tin mineralization with pyrite, sphalerite, arsenopyrite, galena and chalcopyrite in veining, replacements and altered quartz-feldspar porphyry. Sulfides also in breccia dykes. Molybdenite, wolframite and bismuth in veining with increasing depth. Aplite and granite dykes intrude the quartz-feldspar porphyry.		200 300 400 500	3 4 5
Granite III: Mixed siliceous, chloritic, stockwork and brecciated granite.		EOH 587.32	6

Lithological Summary: The collar of hole LNZ-13 is approximately 700 m east of the North Zone. Altered feldspar-porphyry was intersected to 178.9 m. Intervals of greyish-orange "fresh" feldspar porphyry occur prior to 21 m, below which it is consistently altered and locally brecciated. Altered quartz-feldspar

porphyry was intersected between 178.9 and 530.0 m. Biotite alteration locally accompanies silicification and chloritization within the feldspar porphyry and quartz-feldspar porphyry. Breccia dykes (140.9-143.9 m, 193.5-193.6 m, 211.8-213.7 m) intrude feldspar porphyry and quartz-feldspar porphyry at 30°-35° to core axis. Feldspar porphyry is intruded by porphyritic granite dykes between 36.1 and 40.3 m at 30°-40° to core axis. Quartz-feldspar porphyry is intruded by aplite and granite dykes between 489.1 and 527.9 m at 12°-85° to core axis. Tin and sulfide mineralization occur with silica, chlorite and fluorite in veining, replacements, in altered feldspar porphyry and quartz-feldspar porphyry as disseminations, clusters, replacing phenocrysts, and in breccia dykes. Molybdenite and wolframite in minor amounts occur consistantly in veining below 247 m. Altered fine to medium-grained equigranular to porphyritic granite III was intersected at 530.2 m. Low grade endogranitic tin mineralization was intersected at 544.3-546.8 m. Weakly altered to greyish-orange "fresh" granite occurs below 585 m.

Mineralization:

Item	Grade	Width	Interval	Notes
1.	0.11% Sn 0.95% Zn 0.83% Pb 21.2 g/ton Ag	3.0 m	94.5- 97.5 m	Sphalerite, pyrite, arsenopyrite, galena and cassiterite (?) in veining and as replaced phenocrysts in the adjacent siliceous feldspar porphyry.
2.	0.21% Sn 2.73% Zn 6.9 g/ton Ag	3.0 m	140.2-143.2 m	Sphalerite, pyrite and arsenopyrite in veining and breccia dyke matrix. Galena and cassiterite (?) in breccia dyke matrix.
3.	0.27% Sn 3.27% Zn 14.95 g/ton Ag	6.1 m	210.3-216.4 m	Sphalerite, pyrite, arsenopyrite and galena in veining, replacements and breccia dyke matrix as well as disseminations, clusters and replacing phenocrysts in siliceous quartz-feldspar porphyry. Cassiterite in veining and replacements.
4.	0.29% Sn 6.49% Zn 9.55 g/ton Ag	6.1 m	274.3-280.4 m	Sphalerite, pyrite, arsenopyrite, galena and cassiterite (?) in veining, replacements and in adjacent siliceous quartz-feldspar porphyry as disseminations and replacing phenocrysts.
5.	0.39% Sn	3.1 m	326.1-329.2 m	Sphalerite, pyrite, galena, cassiterite, chalcopyrite and molybdenite in veining and replacements.
6.	0.15% Sn	2.5 m	544.3-546.8 m	Cassiterite with pyrite as disseminations and clusters in replacement material and adjacent chloritic granite.

Table II

DIAMOND DRILL HOLE SUMMARY

HOLE NO: LNZ-14 COORDINATES: 14,500 N 16,210 E COLLAR ELEVATION: 1,190

DATE STARTED: 15/07/88 HOLE SIZE: NQ 5.79-154.53 m BQ 154.53-450.78 m CASING: 5.79 m

DATE COMPLETED: 25/07/88

Description	Log	Depth (m)	Intersection
Feldspar Porphyry: "Fresh" to siliceous, chloritic feldspar porphyry.	△ △ △ △ △		x 1
Porphyritic Granite: Mixed siliceous, chloritic, brecciated and biotite altered porphyritic granite. Intervals of "fresh" porphyritic granite within upper 90 m. Sphalerite, pyrite, arsenopyrite, chalcopyrite and galena in veining, breccia matrix and in altered porphyritic granite. Minor tin mineralization locally with sulfides. Magnetite locally in veining and altered porphyritic granite. Minor molybdenite, wolframite and bismuth in veining with increasing depth. Siliceous, chloritic equigranular bands (some with sharp contacts) resemble granite dykes. (McDougall Brook Porphyritic Microgranite)	+ + +

Mineralization:

Item	Grade	Width	Interval	Notes
1.	0.42% Zn 0.80% Pb 10.2 g/ton Ag	3.1 m	57.9-61.0 m	Sphalerite, pyrite and galena in veining and as disseminations in adjacent chloritic feldspar porphyry and chloritic porphyritic granite.
2.	0.06% Sn 0.80% Zn 0.23% Pb 4.6 g/ton Ag	3.1 m	79.2-82.3 m	Sphalerite, pyrite, galena and chalcopyrite in veining and as disseminations, clusters and veinlets in adjacent chloritic porphyritic granite.
3.	0.12% Sn 0.38% Zn 0.27% Pb 4.5 g/ton Ag	3.1 m	97.5-100.6 m	Sphalerite, pyrite, arsenopyrite, galena and chalcopyrite in veining within siliceous, chloritic and brecciated porphyritic granite.
4.	0.18% Zn 0.14% Pb 6.2 g/ton Ag	3.0 m	374.9-377.9 m	Sphalerite, galena, pyrite and trace chalcopyrite in veining and as disseminations, clusters and veinlets in adjacent siliceous, chloritic porphyritic granite.

Table III

DIAMOND DRILL HOLE SUMMARY

HOLE NO: LNZ-18

COORDINATES: 13,392 N
16,390 E

COLLAR ELEVATION: 1,212 m

DATE STARTED: 08/10/88

DATE COMPLETED: 22/10/88

HOLE SIZE: NQ 3.05-145.38 m
BQ 145.38-564.16 m

CASING: 3.05 m

Description	Log	Depth (m)	Intersection
Porphyritic Granite: Mixed chloritic, siliceous and biotite altered porphyritic granite. Alteration varies in intensity. Sulfides occur in veining, breccia dykes and in altered (mainly intense alteration) porphyritic granite. Magnetite occurs locally. (McDougall Brook Porphyritic Microgranite)		100	
Quartz-Feldspar Porphyry: Mixed stockwork, siliceous, chloritic, biotite altered and brecciated quartz-feldspar porphyry. Pyrite, sphalerite, arsenopyrite, chalcopyrite, galena, molybdenite, wolframite and bismuth in veining, local replacements, local breccia matrix and in altered (mainly intense alteration) quartz-feldspar porphyry. Breccia dykes intrude the quartz-feldspar porphyry, hosting sulfides in siliceous fragments and in matrix with chlorite silica and fluorite. Granite dykes intrude the quartz-feldspar porphyry below 540 m.		200 300 400 500 EOH 564.16	
Granite III: Stockwork granite. Arsenopyrite local to siliceous alteration bands. Trace molybdenite in veining.			

Lithological Summary: Hole LNZ-18 was drilled approximately 208 m south-east of LNZ-13, at a dip of approximately -90°. Altered porphyritic granite was intersected to 148.9 m. Veining consist of chlorite, fluorite and silica, locally accompanied by carbonates. Intensity of veining is closely related to alteration intensity. Sparse veining occurs in weak to moderately siliceous, chloritic and biotite altered porphyritic granite while intense (often a stockwork pattern) veining occurs in highly siliceous and chloritic porphyritic granite. Pyrite, arsenopyrite, sphalerite, galena and chalcopyrite occur in veining and locally as disseminations, veinlets and replacing phenocrysts in altered (best in highly siliceous and chloritic) porphyritic granite. Trace wolframite occurs in veining. Magnetite occurs locally as disseminations and clusters mainly within moderately siliceous, chloritic and biotite altered porphyritic granite as well as in scattered sediment fragments. Breccia dykes intrude

the porphyritic granite between 99.9 and 111.0 m and host sulfides. The porphyritic granite is intruded by a siliceous, chloritic granite porphyry dyke at 10.8 - 14.7 m being 28° to core axis. Many of the phenocrysts in this dyke have been replaced by chlorite, fluorite, galena and sphalerite. Altered quartz-feldspar porphyry was intersected between 148.9 and 555.6 m. Sparse to stockwork veining consist of chlorite, silica and fluorite, locally accompanied by biotite and locally by carbonates. Veining along with local replacements (of similar composition) is most intense in highly siliceous, chloritic quartz-feldspar porphyry. Brecciation is local, resulting from intense stockwork veining. Sulfides, wolframite and minor bismuth occur in veining, replacements, breccia matrix and as disseminations, clusters, veinlets and replacing phenocrysts in highly siliceous and chloritic quartz-feldspar porphyry. Trace to minor amounts of cassiterite occur locally in veining and replacements. The quartz-feldspar porphyry is intruded by breccia dykes (163.8 - 164.2 m, 298.6 - 298.7 m, 300.0 - 300.6 m, 302.7 - 303.1 m 346.9 - 347.0 m and 529.2 - 529.6 m) at 5 - 20° to core axis. These breccia dykes host sulfides. The quartz-feldspar porphyry is intruded by granite dykes between 540.7 and 555.1 m at 18° - 73° to core axis. Stockwork granite III was intersected between 555.6 m (contact at 70° to core axis) and end of hole. The granite has a porphyritic texture. Siliceous and chloritic stockwork veining and alteration bands cut the pale orange granite. Arsenopyrite occur as disseminations and replacing phenocrysts within siliceous bands. Siliceous veining host trace amounts of molybdenite.

Table IV

PC-XPLOR VERSION 1.20 GEOPLOT INC.
Exploration Data Manager Serial no: 20000
By GEMCOM SERVICES INC. 23/12/88 Page : 1
*** LAC MINERALS LTD. ***
*** LAC BILLITON TIN PROJECT ***

HOLE-ID: LNZ-13

EASTING: 16320.0 NORTHING:13600.0 ELEVATION: 1216.0
LENGTH: 587.3
LITHOLOGY DATA

FROM	TO	ROCK TYPE	REMARKS
.0	4.0		0.00
4.0	20.7	SIL	FP
20.7	36.1	SIL/CHL	FP
36.1	37.1		GR-DYKE
37.1	38.0	SIL	FP
38.0	39.5		GR-DYKE
39.5	40.1	SIL	FP
40.1	40.3		GR-DYKE
40.3	67.8	SIL	FP
67.8	73.4	CHL	FP
73.4	93.0	SIL/CHL	FP
93.0	95.6	MIX	FP
95.6	102.0	SIL/CHL	FP
102.0	131.1	MIX	FP
131.1	134.1	CHL	FP
134.1	137.2	MIX	FP
137.2	140.9	CHL	FP
140.9	143.9		BX-DYKE
143.9	178.9	MIX	FP
178.9	189.0	SIL/CHL	QFP
189.0	192.0	CHL	QFP
192.0	193.3	SIL/CHL	QFP
193.3	193.6	CHL	BX-DYKE
193.6	201.6	SIL/CHL	QFP
201.6	205.4	STW	QFP
205.4	211.8	MIX	QFP
211.8	213.8		BX-DYKE
213.8	216.4	SIL/CHL	QFP
216.4	219.5	CHL	QFP
219.5	225.6	SIL/CHL	QFP
225.6	231.6	CHL	QFP
231.6	246.3	SIL	QFP
246.3	246.9	SIL/CHL	QFP
246.9	250.0	MIX	QFP
250.0	256.0	SIL	QFP
256.0	262.1	SIL/CHL	QFP
262.1	268.2	SIL	QFP
268.2	276.1	MIX	QFP
276.1	277.6	REPL-ZONES	REPL-ZONES
277.6	290.0	MIX	QFP
290.0	316.0	SIL	QFP
316.0	317.3	REPL-ZONES	REPL-ZONES
317.3	326.1	MIX	QFP
326.1	327.1	REPL-ZONE	REPL-ZONE
327.1	338.3	MIX	QFP
338.3	358.4	SIL	QFP

358.4	362.7	SIL/CHL	QFP
362.7	366.7	MIX	QFP
366.7	384.0	SIL	QFP
384.0	385.3	SIL/CHL	QFP
385.3	385.7	REPL-ZONE	REPL-ZONE
385.7	405.4	MIX	QFP
405.4	411.5	STW	QFP
411.5	414.5	MIX	QFP
414.5	420.6	SIL	QFP
420.6	429.8	MIX	QFP
429.8	437.5	SIL	QFP
437.5	439.8	MIX	QFP
439.8	454.2	SIL	QFP
454.2	466.3	MIX	QFP
466.3	472.4	SIL/CHL	QFP
472.4	477.9	SIL	QFP
477.9	481.6	SIL/CHL	QFP
481.6	485.5	MIX	QFP
485.5	489.1	STW	QFP
489.1	489.3	APL-DYKES	APL-DYKES
489.3	512.1	MIX	QFP
512.1	515.1	STW	QFP
515.1	516.8	MIX	QFP
516.8	518.9	REPL-ZONES	REPL-ZONES
518.9	520.0	MIX	QFP
520.0	521.4	STW	QFP
521.4	521.5	GR-DYKES	GR-DYKES
521.5	523.3	STW	QFP
523.3	527.9	CHL	QFP
527.9	527.9	CHL	GR-DYKE
527.9	530.2	CHL	QFP
530.2	530.7	CHL	GRIII
530.7	541.6	STW	GRIII
541.6	544.4	CHL	GRIII
544.4	546.7	REPL-ZONE	REPL-ZONE
546.7	566.5	STW	GRIII
566.5	573.6	STW/CHL	GRIII
573.6	576.1	MIX	GRIII
576.1	579.1	STW	GRIII
579.1	580.8	STW/CHL	GRIII
580.8	581.2	CHL-VEIN	CHL-VEIN
581.2	584.5	STW/CHL	GRIII
584.5	584.6	GP-DYKE	GP-DYKE
584.6	587.3	GRIII	GRIII
.0	.0		0.00

SAMPLE DATA

FROM	TO	WO3	MOS2	AS	BI	CU	PB	ZN	Sn	FE	SAMPLE#
4.0	6.1	.00	.00	.1	.00	.01	.01 .00	.10	.00	2.76	13329.00
6.1	9.1	.00	.00	.1	.00	.01	.00	.08	.00	2.26	13330.00
9.1	12.2	.00	.00	.0	.00	.02	.00	.09	.03	2.01	13331.00
12.2	15.2	.00	.00	.1	.00	.02	.00	.07	.00	2.12	13332.00
15.2	18.3	.00	.00	.0	.00	.01	.00	.07	.00	2.03	13333.00
18.3	21.3	.00	.00	.1	.00	.02	.01	.10	.00	2.47	13334.00

21.3	24.3	.00	.00	.1	.00	.05	.02	.11	.00	3.48	13335.00
24.3	27.4	.00	.00	.0	.00	.02	.01	.09	.02	5.18	13336.00
27.4	30.5	.00	.00	.1	.00	.07	.01	.10	.02	4.19	13337.00
30.5	33.5	.00	.00	.1	.00	.03	.01	.06	.03	6.02	13338.00
33.5	36.6	.00	.00	.1	.00	.04	.00	.07	.02	4.08	13339.00
36.6	39.6	.00	.00	.1	.00	.02	.00	.08	.02	3.04	13340.00
39.6	42.7	.00	.00	.1	.00	.02	.00	.08	.02	2.52	13341.00
42.7	45.7	.00	.00	.0	.00	.04	.01	.07	.02	2.88	13342.00
45.7	48.8	.00	.00	.0	.00	.03	.00	.05	.02	1.99	13343.00
48.8	51.8	.00	.00	.0	.00	.02	.01	.04	.02	2.29	13344.00
51.8	54.9	.00	.00	.0	.00	.02	.00	.04	.02	2.21	13345.00
54.9	57.9	.00	.00	.0	.00	.02	.00	.03	.02	2.28	13346.00
57.9	61.6	.00	.00	.0	.00	.04	.00	.04	.02	3.89	13347.00
61.6	64.0	.00	.00	.0	.00	.02	.00	.03	.02	1.88	13348.00
64.0	67.1	.00	.00	.0	.00	.03	.01	.06	.02	3.10	13349.00
67.1	70.1	.00	.00	.2	.00	.03	.54	.35	.04	4.77	13350.00
70.1	73.2	.00	.00	.3	.00	.03	.17	.62	.05	7.83	13351.00
73.2	76.2	.00	.00	.0	.00	.02	.01	.08	.02	2.73	13352.00
76.2	79.2	.00	.00	.0	.00	.01	.00	.05	.02	2.69	13353.00
79.2	82.3	.00	.00	.0	.00	.02	.03	.08	.02	2.84	13354.00
82.3	85.3	.00	.00	.0	.00	.01	.03	.08	.02	3.78	13355.00
85.3	88.4	.00	.00	~~.91~~.0	.00	.02	.05	.15	.04	5.99	13356.00
88.4	91.4	.00	.00	.3	.00	.02	.04	.09	.03	6.67	13357.00
91.4	94.5	.00	.00	2.2	.02	.04	.22	.20	.07	6.70	13358.00
94.5	97.5	.00	.00	1.8	.01	.04	.83	.95	.11	8.30	13359.00
97.5	100.6	.02	.00	2.6	.00	.08	.72	.90	.19	9.87	13360.00
100.6	103.6	.00	.00	.5	.00	.07	.20	.45	.16	7.14	13361.00
103.6	106.7	.00	.00	.1	.00	.01	.03	.06	.03	5.31	13362.00
106.7	109.7	.00	.00	.1	.00	.01	.02	.06	.02	4.94	13363.00
109.7	112.8	.00	.00	.1	.00	.01	.00	.05	.02	4.66	13364.00
112.8	115.8	.00	.00	.1	.00	.01	.05	.08	.03	5.85	13365.00
115.8	118.9	.00	.00	.0	.00	.01	.00	.04	.02	4.27	13366.00
118.9	121.9	.00	.00	.1	.00	.01	.00	.04	.02	4.74	13367.00
121.9	125.0	.00	.00	.2	.00	.03	.77	.26	.04	6.45	13368.00
125.0	128.0	.00	.00	.1	.00	.01	.03	.06	.03	7.97	13369.00
128.0	131.1	.00	.00	.1	.00	.01	.07	.10	.03	8.77	13370.00
131.1	134.1	.00	.00	.1	.00	.01	.04	.12	.03	10.69 ****	13371.00
134.1	137.2	.00	.00	.1	.00	.00	.07	.30	.03	9.56	13372.00
137.2	140.2	.00	.00	.4	.00	.00	.28	.25	.03	8.14	13373.00
140.2	143.3	.02	.00	.8	.00	.16	.16	2.73	.21	10.74 ****	13374.00
143.3	146.3	.00	.00	1.4	.00	.03	.29	.79	.11	15.61 ****	13375.00
146.3	149.4	.00	.00	.2	.00	.04	.31	.77	.05	13.03 ****	13376.00
149.4	152.4	.00	.00	.1	.00	.01	.08	.11	.03	12.01 ****	13377.00
152.4	155.4	.00	.00	.1	.01	.02	.01	.05	.02	4.64	13378.00
155.4	158.5	.00	.00	.1	.00	.01	.01	.05	.02	6.86	13379.00
158.5	161.5	.00	.00	.1	.00	.01	.00	.05	.02	5.81	13380.00
161.5	164.6	.00	.00	.1	.00	.02	.00	.06	.02	6.46	13381.00
164.6	167.6	.00	.00	1.3	.02	.02	.00	.05	~~.05~~.02	5.16	13382.00
167.6	170.7	.00	.00	.2	.01	.02	.00	.04	.02	5.54	13383.00
170.7	173.7	.00	.00	.2	.00	.01	.06	.09	.03	7.49	13384.00
173.7	176.8	.00	.00	.1	.00	.01	.00	.03	.02	5.09	13385.00
176.8	179.8	.00	.00	.1	.01	.02	.08	.11	.03	7.39	13386.00
179.8	182.9	.00	.00	.2	.00	.02	.42	.75	.06	5.71	13387.00
182.9	185.9	.00	.00	.1	.00	.03	.04	.11	.04	5.28	13388.00

PC-XPLOR VERSION 1.20
Exploration Data Manager
By GEMCOM SERVICES INC.

GEOPLOT INC.
Serial no: 20000
23/12/88 Page : 4

*** LAC MINERALS LTD. ***
*** LAC BILLITON TIN PROJECT ***

185.9	189.0	.00	.00	.2	.01	.10	.06	.10	.05	5.91	13389.00
189.0	192.0	.00	.00	.3	.00	.02	.22	.34	.03	6.26	13390.00
192.0	195.1	.00	.01	4.5	.00	.03	.65	.67	.05	7.93	13391.00
195.1	198.1	.02	.00	.9	.01	.06	.12	.18	.08	5.63	13392.00
198.1	201.2	.00	.00	1.1	.01	.10	.11	.18	.03	4.70	13393.00
201.2	204.2	.00	.00	.1	.00	.04	.02	.04	.02	4.58	13394.00
204.2	207.3	.00	.00	.2	.00	.18	.05	.28	.07	4.78	13395.00
207.3	210.3	.00	.00	.3	.00	.06	.10	.13	.05	5.10	13396.00
210.3	213.4	.12	.00	7.2	.00	.25	.53	4.70	.36	****	13397.00
213.4	216.4	.01	.00	1.2	.01	.13	.26	1.83	.17	9.60	13398.00
216.4	219.5	.00	.01	.2	.00	.03	.17	.13	.04	****	13399.00
219.5	222.5	.00	.00	.1	.01	.03	.06	.06	.03	4.90	13400.00
222.5	225.6	.00	.00	.2	.01	.11	.07	.09	.03	3.29	13401.00
225.6	228.6	.00	.01	.2	.00	.01	.15	.12	.03	3.46	13402.00
228.6	231.6	.00	.03	.1	.00	.02	.29	.33	.04	3.37	13403.00
231.6	234.6	.00	.00	.0	.01	.02	.01	.03	.02	1.63	13404.00
234.6	237.7	.00	.00	.1	.01	.02	.00	.03	.02	1.33	13405.00
237.7	240.7	.00	.00	.0	.00	.01	.00	.03	.02	1.34	13406.00
240.7	243.8	.00	.00	.0	.00	.02	.00	.03	.02	1.55	13407.00
243.8	246.9	.00	.01	.3	.00	.08	.51	.63	.03	2.74	13408.00
246.9	249.9	.02	.02	.1	.00	.07	.21	.53	.13	2.50	13409.00
249.9	253.0	.05	.00	.0	.00	.01	.01	.03	.02	1.10	13410.00
253.0	256.0	.12	.02	.0	.00	.02	.01	.02	.02	1.06	13411.00
256.0	259.1	.00	.01	.1	.00	.11	.81	1.43	.13	3.27	13412.00
259.1	262.1	.00	.00	.1	.00	.01	.04	.05	.02	5.87	13413.00
262.1	265.2	.00	.00	.0	.00	.01	.02	.03	.02	1.02	13414.00
265.2	268.2	.00	.01	.1	.01	.01	.02	.03	.02	.84	13415.00
268.2	271.3	.00	.00	.1	.00	.02	.52	.36	.05	5.37	13416.00
271.3	274.3	.12	.10	.1	.01	.01	.10	.08	.03	4.80	13417.00
274.3	277.4	.08	.01	.4	.00	.13	.26	7.55	.30	5.42	13418.00
277.4	280.4	.08	.02	.4	.01	.12	.35	5.43	.28	6.79	13419.00
280.4	283.5	.00	.00	.1	.00	.00	.08	.11	.03	4.63	13420.00
283.5	286.5	.00	.00	.1	.01	.03	.07	.08	.02	3.76	13421.00
286.5	289.6	.02	.00	.0	.00	.01	.02	.05	.02	1.16	13422.00
289.6	292.6	.00	.00	.1	.01	.01	.07	.07	.03	2.67	13423.00
292.6	295.7	.02	.01	.0	.01	.01	.00	.02	.02	.34	13424.00
295.7	298.7	.00	.00	.0	.01	.01	.00	.02	.02	1.52	13425.00
298.7	301.8	.00	.01	.0	.01	.01	.00	.01	.02	.63	13426.00
301.8	304.8	.00	.00	.0	.00	.01	.00	.02	.02	.51	13427.00
304.8	307.8	.00	.01	.1	.01	.01	.01	.01	.02	.87	13428.00
307.8	310.9	.00	.01	.0	.00	.01	.01	.02	.00	.65	13429.00
310.9	313.9	.00	.02	.0	.00	.01	.00	.01	.00	.67	13430.00
313.9	317.0	.01	.00	.1	.01	.01	.02	.09	.20	5.83	13431.00
317.0	320.0	.00	.01	.1	.02	.01	.08	.14	.04	6.31	13432.00
320.0	323.1	.00	.01	.0	.01	.01	.03	.03	.00	1.96	13433.00
323.1	326.1	.00	.01	.0	.01	.01	.03	.04	.00	1.08	13434.00
326.1	329.2	.07	.14	.1	.04	.07	.25	.17	.39	****	13435.00
329.2	332.2	.00	.04	.0	.01	.01	.05	.03	.00	3.12	13436.00
332.2	335.3	.00	.02	.0	.01	.01	.03	.05	.00	1.50	13437.00
335.3	338.3	.00	.00	.0	.00	.01	.03	.04	.00	2.42	13438.00
338.3	341.4	.18	.01	.0	.01	.01	.01	.05	.00	.99	13439.00
341.4	344.4	.00	.00	.0	.01	.00	.01	.02	.00	.66	13440.00
344.4	347.5	.00	.01	.1	.00	.01	.01	.04	.00	1.66	13441.00
347.5	350.5	.00	.01	.1	.01	.03	.00	.03	.00	.81	13442.00

350.5	353.6	.00	.02	.0	.01	.01	.01	.00	.00	.69	13443.00
353.6	356.6	.00	.04	.0	.01	.01	.00	.00	.00	.83	13444.00
356.6	359.7	.00	.01	.0	.01	.00	.01	.02	.00	.57	13445.00
359.7	362.7	.07	.02	.1	.02	.01	.02	.02	.00	.75	13446.00
362.7	365.8	.00	.04	.1	.02	.03	.01	.02	.00	1.95	13447.00
365.8	368.8	.00	.02	.1	.00	.01	.00	.02	.00	1.01	13448.00
368.8	371.9	.00	.01	.1	.01	.01	.01	.01	.00	1.10	13449.00
371.9	374.9	.00	.01	.1	.01	.01	.00	.00	.00	.66	13450.00
374.9	378.0	.00	.03	.0	.01	.01	.00	.00	.00	.77	13451.00
378.0	381.0	.00	.03	.0	.01	.02	.00	.00	.00	1.49	13452.00
381.0	384.0	.00	.01	.0	.00	.01	.01	.01	.00	.86	13453.00
384.0	387.1	.00	.01	.1	.01	.01	.19	.22	.03	6.86	13454.00
387.1	390.1	.00	.01	.0	.01	.01	.01	.02	.00	1.31	13455.00
390.1	393.2	.00	.01	.0	.01	.01	.01	.00	.00	1.85	13456.00
393.2	396.2	.00	.03	.0	.02	.01	.02	.00	.00	1.95	13457.00
396.2	399.3	.00	.02	.1	.02	.02	.02	.03	.00	1.68	13458.00
399.3	402.3	.00	.03	.1	.02	.01	.03	.05	.00	1.62	13459.00
402.3	405.4	.14	.05	.9	.04	.01	.01	.00	.00	1.31	13460.00
405.4	408.4	.00	.01	.0	.01	.01	.01	.00	.00	1.10	13461.00
408.4	411.5	.18	.03	.1	.02	.01	.00	.00	.00	.91	13462.00
411.5	414.5	.00	.10	.1	.07	.01	.02	.00	.00	1.50	13463.00
414.5	417.6	.00	.02	.1	.02	.02	.01	.00	.00	1.61	13464.00
417.6	420.6	.00	.04	.0	.02	.01	.01	.00	.00	1.21	13465.00
420.6	423.7	.00	.04	.1	.02	.00	.07	.08	.00	2.83	13466.00
423.7	426.7	.00	.01	.1	.05	.01	.01	.00	.00	1.30	13467.00
426.7	429.8	.00	.05	.1	.01	.00	.00	.43	.00	3.59	13468.00
429.8	432.8	.00	.02	.0	.01	.00	.00	.00	.00	.97	13469.00
432.8	435.9	.00	.09	.0	.01	.01	.00	.00	.00	.89	13470.00
435.9	438.9	.03	.05	.0	.05	.01	.01	.00	.00	3.93	13471.00
438.9	442.0	.00	.02	.0	.02	.00	.00	.00	.00	2.98	13472.00
442.0	445.0	.02	.05	.1	.02	.00	.01	.00	.00	1.34	13473.00
445.0	448.1	.00	.11	.1	.03	.01	.00	.00	.00	.86	13474.00
448.1	451.1	.00	.05	.1	.02	.01	.00	.00	.00	1.08	13475.00
451.1	454.2	.02	.06	.1	.02	.00	.00	.00	.00	1.22	13476.00
454.2	457.2	.00	.05	.1	.01	.01	.01	.00	.00	1.51	13477.00
457.2	460.2	.00	.06	.1	.02	.01	.02	.00	.00	1.50	13478.00
460.2	463.2	.01	.12	.1	.02	.01	.01	.00	.00	1.80	13479.00
463.2	466.3	.05	.05	.2	.02	.00	.00	.90	.00	4.04	13480.00
466.3	469.4	.00	.05	.0	.02	.01	.00	.00	.00	.83	13481.00
469.4	472.4	.14	.11	.1	.02	.01	.00	.00	.00	.90	13482.00
472.4	475.5	.00	.07	.0	.01	.01	.01	.00	.00	.84	13483.00
475.5	478.5	.00	.09	.1	.02	.00	.00	.00	.00	1.00	13484.00
478.5	481.6	.00	.06	.1	.01	.01	.01	.00	.00	2.86	13485.00
481.6	484.6	.02	.09	.3	.06	.01	.00	.00	.00	3.24	13486.00
484.6	487.7	.00	.05	.3	.01	.00	.00	.00	.00	1.57	13487.00
487.7	490.7	.01	.07	.2	.01	.01	.00	.00	.00	2.33	13488.00
490.7	493.8	.08	.09	.2	.04	.00	.00	.00	.00	3.25	13489.00
493.8	496.8	.00	.14	.1	.02	.01	.00	.00	.00	1.52	13490.00
496.8	499.9	.00	.15	.1	.02	.00	.00	.00	.00	3.10	13491.00
499.9	502.9	.00	.11	.1	.03	.01	.01	.00	.00	2.68	13492.00
502.9	506.0	.00	.07	.0	.02	.01	.01	.00	.00	1.84	13493.00
506.0	509.0	.01	.04	.1	.02	.01	.00	.00	.00	2.22	13494.00
509.0	512.1	.00	.08	.1	.01	.01	.00	.00	.00	2.06	13495.00
512.1	515.1	.00	.06	.2	.02	.01	.00	.00	.00	2.73	13496.00

515.1	518.2	.00	.11	.3	.03	.01	.00	.00	.00	5.22	13497.00
518.2	521.2	.03	.11	.0	.07	.01	.00	.00	.02	3.73	13498.00
521.2	524.3	.00	.06	.0	.01	.01	.02	.00	.00	1.32	13499.00
524.3	527.3	.00	.11	.0	.02	.01	.00	.00	.00	1.73	13500.00
527.3	530.4	.00	.08	.0	.01	.01	.00	.00	.00	3.33	13501.00
530.4	533.4	.00	.01	.0	.00	.00	.00	.00	.00	.95	13502.00
533.4	536.4	.00	.01	.0	.00	.00	.00	.00	.00	.91	13503.00
536.4	539.5	.00	.00	.0	.00	.01	.00	.00	.00	.00	13504.00
539.5	542.5	.00	.00	.0	.01	.00	.02	.02	.00	.91	13505.00
542.5	544.4	.00	.00	.0	.01	.00	.02	.06	.00	2.84	13506.00
544.4	546.8	.00	.01	.0	.01	.01	.02	.04	.15	6.96	13507.00
546.8	548.6	.00	.01	.0	.01	.01	.01	.00	.00	.99	13508.00
548.6	551.7	.00	.00	.0	.00	.00	.01	.00	.00	.00	13509.00
551.7	554.7	.00	.00	.0	.00	.00	.01	.00	.00	.00	13510.00
554.7	557.8	.00	.02	.0	.04	.00	.01	.00	.00	1.51	13511.00
557.8	560.8	.00	.01	.0	.00	.00	.01	.00	.00	.14	13512.00
560.8	563.9	.00	.00	.0	.01	.00	.00	.00	.00	.00	13513.00
563.9	566.9	.00	.00	.0	.00	.00	.00	.00	.00	1.36	13514.00
566.9	570.0	.00	.00	.0	.00	.01	.00	.00	.00	1.66	13515.00
570.0	573.0	.00	.00	.0	.00	.00	.00	.00	.00	.05	13516.00
573.0	576.1	.00	.00	.1	.01	.05	.00	.01	.00	2.51	13517.00
576.1	579.1	.00	.00	.0	.01	.00	.00	.00	.00	.68	13518.00
579.1	582.2	.00	.00	.0	.01	.00	.00	.00	.00	1.27	13519.00
582.2	585.2	.00	.00	.0	.01	.00	.00	.00	.00	.48	13520.00
585.2	587.3	.00	.00	.0	.01	.00	.00	.00	.00	.00	13521.00
.0	.0	.00	.00	.0	.00	.00	.00	.00	.00	.00	.00

Table V

PC-XPLOR VERSION 1.20
Exploration Data Manager
By GEMCOM SERVICES INC.

GEOPLOT INC.
Serial no: 20000
23/12/88 Page : 7

*** LAC MINERALS LTD. ***
*** LAC BILLITON TIN PROJECT ***

HOLE-ID: LNZ-14

EASTING: 16210.0 NORTHING: 14500.0 ELEVATION: 1190.0
LENGTH: 450.8
LITHOLOGY DATA

FROM	TO	ROCK TYPE	REMARKS
.0	5.2		
5.2	6.4	SIL	FP
6.4	9.1	FP	FP
9.1	18.3	SIL	FP
18.3	24.4	SIL/CHL	FP
24.4	27.4	SIL	FP
27.4	31.4	FP	FP
31.4	40.8	SIL/CHL	FP
40.8	54.2	FP	FP
54.2	57.3	SIL/CHL	PORPH-GR
57.3	59.6	SIL/CHL	FP
59.6	79.2	SIL/CHL	PORPH-GR
79.2	82.9	CHL	PORPH-GR
82.9	97.2	SIL/CHL	PORPH-GR
97.2	100.5	MIX	PORPH-GR
100.5	106.4	SIL/CHL	PORPH-GR
106.4	109.7	P-GR	PORPH-GR
109.7	118.7	SIL/CHL	PORPH-GR
118.7	124.1	CHL	PORPH-GR
124.1	125.7	SIL	FP
125.7	131.1	CHL	PORPH-GR
131.1	132.7	BX	BX
132.7	133.8	CHL	PORPH-GR
133.8	134.7	SIL/CHL	FP
134.7	136.0	SIL/CHL	PORPH-GR
136.0	136.6	SIL/CHL	FP
136.6	137.0	SIL/CHL	GR-DYKE
137.0	140.5	CHL	FP
140.5	162.6	SIL/CHL	PORPH-GR
162.6	164.8	FI/SIL/CHL	FI/SIL/CHL
164.8	167.6	CHL/BX	PORPH-GR
167.6	170.7	CHL	PORPH-GR
170.7	185.9	MIX	PORPH-GR
185.9	235.6	SIL/CHL	PORPH-GR
235.6	237.7	CHL	PORPH-GR
237.7	260.6	SIL/CHL	PORPH-GR
260.6	264.3	CHL	PORPH-GR
264.3	283.5	MIX	PORPH-GR
283.5	324.9	SIL/CHL	PORPH-GR
324.9	329.2	CHL	PORPH-GR
329.2	383.2	SIL/CHL	PORPH-GR
383.2	385.4	CHL	PORPH-GR
385.4	405.4	SIL/CHL	PORPH-GR
405.4	408.4	MIX	PORPH-GR
408.4	423.7	SIL/CHL	PORPH-GR
423.7	438.9	MIX	PORPH-GR

438.9	445.0	SIL/CHL	PORPH-GR
445.0	450.8	MIX	PORPH-GR
.0	.0	0.00	0.00
.0	.0	0.00	0.00

SAMPLE DATA

FROM	TO	WO3	MOS2	AS	BI	CU	PB	ZN	Sn	FE	SAMPLE#
57.9	61.0	.00	.00	.0	.00	.00	.80	.42	.00	6.56	13522.00
67.1	70.1	.00	.00	.0	.00	.00	.04	.14	.00	3.14	13523.00
79.2	82.3	.00	.00	.3	.00	.09	.23	.80	.06	9.09	13524.00
97.5	100.6	.00	.00	.2	.06	.06	.27	.38	.12	5.69	13525.00
128.0	131.1	.00	.00	.0	.00	.01	.04	.14	.00	7.60	13526.00
161.5	164.6	.00	.02	.0	.00	.00	.00	.02	.00	2.15	13527.00
213.4	216.4	.00	.00	.0	.00	.00	.04	.04	.00	2.77	13528.00
262.1	265.2	.00	.00	.0	.00	.01	.02	.12	.03	6.50	13529.00
326.1	329.2	.00	.00	.0	.00	.01	.00	.02	.00	3.46	13530.00
374.9	378.0	.00	.00	.0	.01	.02	.14	.18	.00	5.96	13531.00

Table VI

PC-XPLOR VERSION 1.20
Exploration Data Manager
By GEMCOM SERVICES INC.

GEOPLOT INC.
Serial no: 20000
23/12/88 Page : 20

*** LAC MINERALS LTD. ***
*** LAC BILLITON TIN PROJECT ***

HOLE-ID: LNZ-18

EASTING: 16390.0 NORTHING: 13392.0 ELEVATION: 1212.0
LENGTH: 563.9
LITHOLOGY DATA

FROM	TO	ROCK TYPE	REMARKS
.0	3.4		
3.4	6.1	CHL	PORPH-GR
6.1	10.8	MIX	PORPH-GR
10.8	14.7	SIL/CHL	GP-DYKE
14.7	21.3	MIX	PORPH-GR
21.3	42.7	SIL/CHL	PORPH-GR
42.7	45.7	STW	PORPH-GR
45.7	57.9	SIL/CHL	PORPH-GR
57.9	64.0	MIX	PORPH-GR
64.0	91.4	SIL/CHL	PORPH-GR
91.4	99.9	CHL	PORPH-GR
99.9	100.1	SIL/CHL	BX-DYKE
100.1	101.5	CHL	PORPH-GR
101.5	102.6	BX-DYKES	BX-DYKES
102.6	104.6	CHL/SIL	PORPH-GR
104.6	105.4	BX-DYKE	BX-DYKE
105.4	110.9	CHL/SIL	PORPH-GR
110.9	111.0	CHL/SIL	BX-DYKE
111.0	115.8	CHL/SIL	PORPH-GR
115.8	121.9	CHL	PORPH-GR
121.9	128.2	CHL/SIL	PORPH-GR
128.2	129.1	BX	PORPH-GR
129.1	148.8	CHVSIL	PORPH-GR
148.8	155.4	MIX	QFP
155.4	158.5	SIL/STW	QFP
158.5	161.5	SIL	QFP
161.5	163.8	CHL/STW	QFP
163.8	164.2	BX-DYKE	BX-DYKE
164.2	176.8	MIX	QFP
176.8	185.9	STW	QFP
185.9	197.2	MIX	QFP
197.2	202.7	SIL/CHL	QFP
202.7	207.3	MIX	QFP
207.3	210.1	STW	QFP
210.1	219.5	SIL	QFP
219.5	225.6	SIL/STW	QFP
225.6	231.6	MIX	QFP
231.6	249.0	SIL	QFP
249.0	252.8	MIX	QFP
252.8	253.3	REPL-ZONE	REPL-ZONE
253.3	256.5	MIX	QFP
256.5	271.3	SIL	QFP
271.3	277.4	SIL/STW	QFP
277.4	298.6	SIL	QFP
298.6	298.7	CHL	BX-DYKE
298.7	300.0	SIL/STW	QFP

300.0	300.7	CHL	BX-DYKE
300.7	302.7	STW	QFP
302.7	303.1	CHL	BX-DYKES
303.1	317.0	SIL	QFP
317.0	320.0	SIL/CHL	QFP
320.0	327.6	CHL	QFP
327.6	346.9	MIX	QFP
346.9	347.0	CHL	BX-DYKE
347.0	350.5	CHL	QFP
350.5	355.1	CHL/STW	QFP
355.1	358.6	BX	QFP
358.6	362.7	CHL/BX	QFP
362.7	381.0	MIX	QFP
381.0	417.6	SIL	QFP
417.6	425.0	MIX	QFP
425.0	425.3	REPL-ZONE	REPL-ZONE
425.3	426.7	MIX	QFP
426.7	432.8	STW	QFP
432.8	438.9	SIL/STW	QFP
438.9	445.0	MIX	QFP
445.0	448.2	STW	QFP
448.2	457.2	SIL	QFP
457.2	460.2	MIX	QFP
460.2	469.4	SIL	QFP
469.4	481.6	SIL/STW	QFP
481.6	484.6	MIX	QFP
484.6	490.7	SIL	QFP
490.7	505.9	MIX	QFP
505.9	508.2	SIL/CHL	QFP
508.2	508.4	REPL-ZONE	REPL-ZONE
508.4	511.3	SIL/CHL	QFP
511.3	515.0	SIL/STW	QFP
515.0	527.3	MIX	QFP
527.3	529.2	STW	QFP
529.2	529.6	SIL/CHL	BX-DYKE
529.6	533.4	STW	QFP
533.4	536.4	SIL	QFP
536.4	540.7	SIL/STW	QFP
540.7	555.6	SIL	QFP/GR-DYKES
555.6	564.2	STW	GRIII
.0	.0	0.00	0.00

SAMPLE DATA

FROM	TO	WO3	MOS2	AS	BI	CU	PB	ZN	Sn	FE	SAMPLE#
----	--	---	----	--	--	--	--	--	--	--	-------

STATEMENT OF EXPENDITURES

Project 8713-21G7

Year to December 31, 1988

Salaries and wages	$16,210.54
Diamond drilling	123,136.65
Assays and core handling	2,902.39
Drafting	49.34
Storage	1,398.00
Vehicle operation and maintenance	293.41
Travel	9.99
Courier and freight	288.27
Total	$144,288.59

Enclosures

Diamond drill contractor invoices.

Longyear

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone: 705-474-2800
Telex: 067-76194 Cable: Longyear
Fax: 705-474-2373

Lac Minerals Ltd.
P.O. Box 150
St. George, New Brunswick
E0G 2Y0

Invoice No. 3265
Cust. No. 2107
Job No. 2184
Dest. 065

Invoice date July 11, 1988
for June 1988

To: Invoice for diamond drilling performed on mining properties located near the Mount Pleasant Tungsten Mine (MPT) during the period June 13 - 29, 1988 per agreement dated May 24, 1988.

Hole #	Size	From	To	Total	Rate	Amount
LNZ-13	NQ Wireline	0.	71.02m	71.02m	49.50	3,515.49
	BQ Wireline	71.02m	88.39m	17.37m	44.00	764.28
	NQ Wireline	88.39m	150.88m	62.49m	49.50	3,093.26
	BQ Wireline	150.88m	300.00m	149.12m	44.00	6,561.28
	BQ Wireline	300.00m	375.21m	75.21m	47.70	3,587.52
				375.21m		17,521.83

Mobilization and Demobilization

Lump Sum, $2,250.00 @ 75% 1,687.50

Move In (Initial Site)

14 hrs. @ $70.00	980.00	
44 Extra Crew hrs. @ $28.00	1,232.00	
13 Tractor hrs. @ $40.00	520.00	
		2,732.00

Hole Reduction

Hole LNZ-13

18 hrs. @ $70.00		1,260.00	
2 BW Econo Shoe 701,706 @ $120.00	240.00		
Plus 15%	36.00		
		276.00	
			1,536.00

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone: 705-474-2800
Telex: 067-76194 Cable: Longyear
Fax: 705-474-2373

Lac Minerals Ltd. Invoice No. 3265

Reaming			
Hole LNZ-13			
5 hrs. @ $70.00		350.00	
1 NQ #2 Bit 92372	500.00		
Plus 15%	75.00		
		575.00	
			925.00
Wedging			
Hole LNZ-13			
41 hrs. @ $70.00		2,870.00	
20 Extra Crew hrs. @ $28.00		560.00	
1 BQ Wedge	472.35		
1 Bag Portland Cement	8.75		
1 BQ Wedge Bit T29132	581.00		
1 BQ Econo Shell E180	165.00		
1 BQ #2 Bit 86849	340.00		
	1,567.10		
Plus 15%	235.07		
		1,802.17	
			5,232.17
Mud & Additives			
Canadian Pipe Supply Ltd.		5,529.04	
Plus 15%		829.36	
			6,358.40
Tropari Rental			
June 13 - 30, 1988, 18/30 x $500.00			300.00
			$36,292.90

Longyear

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone: 705-474-2800
Telex: 067-76194 Cable: Longyear
Fax: 705-474-2373

Lac Minerals Limited
P.O. Box 150
St. George, New Brunswick
EOG 2YO

Invoice No. 3404
Cust. No. 2107
Job No. 2184
Dest. 065

Invoice date July 26, 1988
for July 1988

To: Invoice for diamond drilling performed on mining properties located near Mount Pleasant Tungsten Mine (MPT) During the period July 4 To July 17, 1988 per agreement dated May 24, 1988

HOLE NO.	SIZE	FROM	TO	TOTAL	RATE	AMOUNT
LNZ-13	BQ Wireline	375.21m	587.35m	212.14m	47.70	10,119.08
LNZ-14	NQ Wireline	0	154.53m	154.53m	49.50	7,649.24
	BQ Wireline	154.53m	169.77m	15.24m	44.00	670.56
				381.91m		$18,438.88

Reaming
Hole LNZ-13

6 Hrs. @ $70.00 — 420.00

Moves
From Hole LNZ-13 to LNZ-14

30 Hrs. @ $70.00	2,100.00	
40 Extra Crew Hrs. @ $28.00	1,120.00	
16 Tractor Hrs. @ $40.00	640.00	
12 Truck Float Hrs. @ $40.00	480.00	
		4,340.00

Client Testing

3 Hrs. @ $70.00 — 210.00

Longyear

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone: 705-474-2800
Telex: 067-76194 Cable: Longyear
Fax: 705-474-2373

Lac Minerals

Invoice No. 3404

Left In Hole		
Hole LNZ-13		
1 - NW 2 Ft. Casing	47.00	
1 - NW 10 Ft. Casing	137.85	
1 - NW Econo Shoe E-1596	160.00	
		344.85
Hole Reduction		
Hole LNZ-14		
6 Hrs. @ $70.00		420.00
Tropari Rental		
July 1 - July 17, 1988		
17/31 @ $500.00		274.19
		$24,447.92

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone: 705-474-2800
Telex: 067-76194 Cable: Longyear
Fax: 705-474-2373

Lac Minerals Limited,
P.O. Box 150,
St. George, New Brunswick.
EOG 2YO.

Invoice No. 3405
Cust. No. 2107
Job No. 2184
Dest. 065

Invoice date August 9, 1988
for July 1988

To: Invoice for diamond drilling performed on mining properties located near the Mount Pleasant Tungsten Mine (MPT) during the period July 18 To July 27, 1988 per agreement dated May 24, 1988

HOLE NO.	SIZE	FROM	TO	TOTAL	RATE	AMOUNT
LNZ-14	BQ Wireline	169.77m	300.00m	130.23m	44.00	5,730.12
	BQ Wireline	300.00m	450.80m	150.80m	47.70	7,193.16
				281.03M		12,923.28

Reaming
Hole LNZ-14

1 1/2 Hrs. @ 70.00 — 105.00

Moves
From Hole LNZ-14 To Hole LNZ-15

25 Hrs. @ 70.00	1,750.00	
62 Extra Crew Hrs. @ 28.00	1,736.00	
23 Tractor Hrs. @ 40.00	920.00	
12 Truck Float Hrs. @ 40.00	480.00	
		4,886.00

Hole Reductions (Pulling Rods Used As Casing)
Hole LNZ-14

2 Hrs. @ 70.00 — 140.00

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone: 705-474-2800
Telex: 067-76194 Cable: Longyear
Fax: 705-474-2373

Lac Minerals

Invoice No. 3405

Left In Hole:
Hole LNZ-14

2 - NW 2 Ft. Casing @ 47.00	94.00	
1 - NW 5 Ft. Casing	80.95	
1 - NW 10 Ft. Casing	137.85	
1 - NW Econo Shoe E-2014	160.00	
		472.80

Tropari Rental

July 18 - July 31, 1988
14/31 @ 500.00 225.81

$18,752.89

TERMS – NET 30 DAYS – INTEREST CHARGED AT 1 1/2% PER MONTH ON OVERDUE ACCOUNTS

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 190, North Bay, Ontario, Canada P1B 8H6
Telephone: 705 474 2800
Telex: 06 76194 Cable: Longyear
Fax: 705 474 2373

ORIGINAL

Lac Minerals Limited,
P.O. Box 150,
St. George, New Brunswick.
EOG 2Y0.

Invoice No. 3815
Customer No. 2107
Job No. 2184
Cust. No. 065

Invoice Date: October 27, 1988
for October 1988

To: Invoice for diamond drilling performed on mining properties located near the Mount Pleasant Tungsten Mine (MPT) during the period October 4-16, 1988 per agreement dated May 24, 1988.

HOLE NO.	SIZE	FROM	TO	TOTAL	RATE	AMOUNT
LNZ-15	BQ Wireline	564.79m	584.30m	19.51m	47.70	930.63
LNZ-18	NQ Wireline	0	145.39m	145.39m	49.50	7,196.81
	BQ Wireline	145.39m	300.00m	154.61m	44.00	6,802.84
	BQ Wireline	300.00m	416.66m	116.66m	47.70	5,564.68
				436.17m		20,494.96

Long Waterlines
Hole LNZ-18
1 Hr. 70.00

Hole Reduction
Hole LNZ-15

1 1/2 Hrs. @ $70.00		105.00	
19 - NQ 10 Ft. Rods @ $120.00	2,280.00		
1 - BW Econo Shoe E703	120.00		
1 - NQ Recovery Tap (11920)	142.40		
	2,542.40		
Plus: 15%	381.36		
		2,923.76	
			3,028.76

Hole LNZ-18
1 Hr. 70.00
3,098.76

Moves
From Hole LNZ-15 To Hole LNZ-18

19 Hrs. @ $70.00	1,330.00	
53 1/2 Extra Crew Hours @ $28.00	1,498.00	
22 1/2 Tractor Hours @ $40.00	900.00	
		3,728.00

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box [illegible], Thunder Bay, Ontario [illegible]
[illegible]
[illegible]
Fax [illegible]

Hole Conditions Hole LNZ-18		70.00
1 Hour		
Mud & Additives 29 Gallons Diesel Fuel @ $2.16 Plus: 15%	62.64 9.40	72.04
Tropari Rental		241.94
October 1-15, 1988 15/31 @ $500.00		$27,775.70

Longyear

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone 705-474-9800
Telex 067 76194 Cable Longyear
Fax 705-474-0373

ORIGINAL

Lac Minerals Ltd.
P. O. Box 150
St. George, New Brunswick
EOG 2YO

Invoice No.: 3811
Cust. No.: 2107
Job No.: 2184
Dest.: 065
Invoice Date: November 9, 1988
For October 1988

TO: Invoice for diamond drilling performed on mining properties located near the Mount Pleasant Tungsten Mine (MPT) during the period October 17 - 24, 1988 per Agreement dated May 24, 1988.

Hole #	Size	From	To	Total	Rate	Amount
LNZ-18	BQ Wireline	416.66m	563.88m	147.22m	47.70	7022.39
Mobilization & Demobilization						
Lump Sum - 2250.00 @ 25%						562.50
Hole Conditions:						
Hole LNZ-18						
8 1/2 Hours @ $70.00					595.00	
43 NQ 10' Drill Rods @ $120.00				5160.00		
Plus 15%				774.00		
					5934.00	
						6529.00
Moves						
Moving From Hole LNZ-18						
16 Hours @ $70.00					1120.00	
20 Extra Crew Hours @ $28.00					560.00	
14 Tractor Hours @ $40.00					560.00	
						2240.00
Mud & Additives						
20 Gallons Diesel Fuel @ $2.16					43.20	
Harold McNamara - Attached					471.75	
Day & Ross Invoice					1055.76	
					1570.71	
Plus 15%					235.61	
						1806.32

.../2

Longyear

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, Canada P1B 8H6
Telephone 705 474 2800
Telex 067 76194 Cable Longyear
Fax 705 474 2373

Lac Minerals Ltd.
PAGE 2 - CONTINUED

Tropari Rental

October 16 - 24, 1988	9/31 @ $500.00	145.16
		$18305.37

Longyear Canada Inc.
CONTRACT DRILLING DIVISION
P.O. Box 330, North Bay, Ontario, P1B 8H2
Telephone: 705 474-2600
Telex 06-76194 Cable Longyear
Fax 705 474-2313

Lac Minerals Limited,
P.O. Box 150,
St. George, New Brunswick.
EOG 2Y0.

Invoice No. 3816
Cust. No. 2107
Job No. 2184
Dest. 065

Invoice date November 2, 1988
for October 1988

To: Invoice for diamond drilling performed on mining properties located near the Mount Pleasant Tungsten Mine (MPT) during the period October 4-16, 1988 per agreement dated May 24, 2988.

ADJUSTMENT TO INVOICE 3815

Moves			
From Hole LNZ-15 To Hole LNZ-18			
22 1/1 Tractor Hours @ $40.00 (Charged)	900.00		
21 1/1 Tractor Hours @ $40.00 (Should Be Charged)	860.00		
		($40.00)	
53 1/2 Extra Crew Hrs. @ $28.00 (Charged)	1,498.00		
43 1/2 Extra Crew Hrs. @ $28.00 (Should Be Charged)	1,218.00		
		($280.00)	
			($320.00)
Truck And Trailer Used			
21 Hrs. @ $40.00			840.00
			$520.00

Geological setting of granites and related tin deposits in the North Zone, Mount Pleasant, New Brunswick

W. David Sinclair, Gustaaf J.A. Kooiman,[1] and David A. Martin[1]
Mineral Resources Division

Sinclair, W.D., Kooiman, G.J.A., and Martin, D.A.; Geological setting of granites and related tin deposits in the North Zone, Mount Pleasant, New Brunswick; in Current Research, Part B, Geological Survey of Canada, Paper 88-1B, p. 201-208, 1988.

Abstract

Granitic intrusions and associated mineral deposits at Mount Pleasant were emplaced in a subvolcanic environment near the southwestern margin of the Mount Pleasant caldera. Mineral deposits in the North Zone are associated with three phases of granite. Tungsten-molybdenum deposits apear to be related to the oldest phase (Granite I). Most tin deposits are within, or adjacent to, an intermediate phase (Granite II). The youngest phase (Granite III) has only minor associated tin zones. Textural features of Granite II, such as miarolitic cavities and comb quartz layers, are characteristic of fluid saturation in the parent magma. Other features such as micrographic intergrowths of quartz and K-feldspar reflect undercooled conditions that may have been related to rapid release of a fluid phase (i.e. pressure quenching). The association of the tin deposits with granite containing these features indicates that a significant portion of the mineralizing fluids were magmatic.

Résumé

Les intrusions granitiques et les gisements de minéraux associés que l'on trouve sur les lieux du mont Pleasant ont été mis en place dans un milieu subvolcanique près de la marge sud-ouest de la caldeira de Pleasant Mount. Les gisements de minéraux de la zone nord sont associés à trois phases de granite. Des gisements de tungstène et molybdène semblent être apparentés à la phase la plus ancienne (Granite I). La plupart des gisements d'étain se trouvent à l'intérieur ou contigus à une phase intermédiaire (Granite II). La phase la plus récente (Granite III) ne possède que de petites zones d'étain connexes. Les éléments texturaux de Granite II, comme les cavités miarolithiques et les couches de quartz à épontes fortement minéralisées et presque jointives, sont caractéristiques d'une phase de saturation fluide au sein du magma originel. D'autres particularités comme les intercroissances micrographiques de quartz et de feldspath potassique reflètent des conditions de sous-refroidissement qui peuvent avoir été liées à la libération rapide d'une phase fluide (c'est-à-dire la trempe sous pression). L'association des gisements d'étain au granite renfermant ces éléments révèle qu'une partie appréciable des fluides minéralisateurs sont d'origine magmatique.

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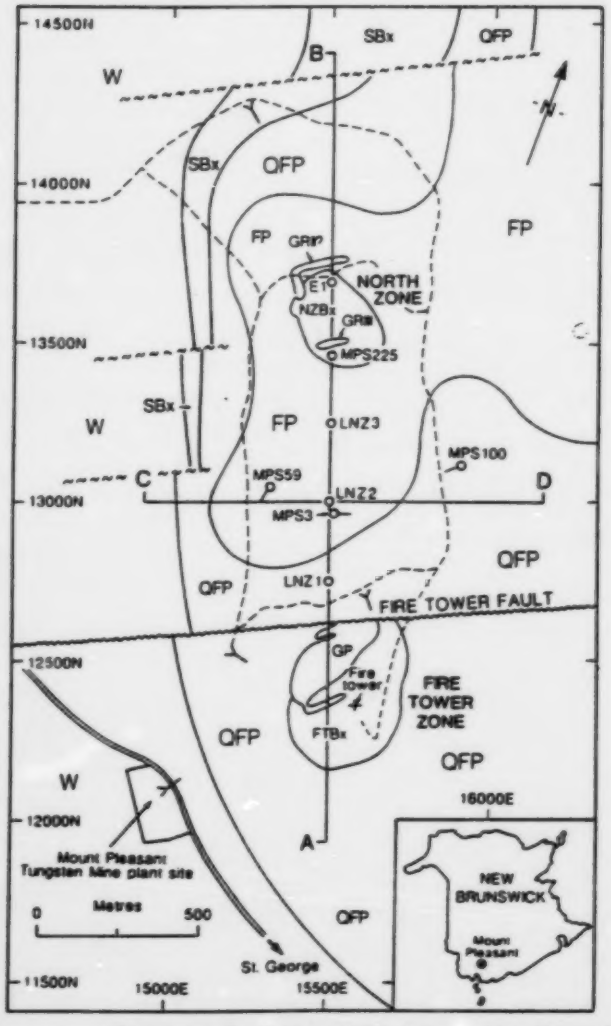
INTRODUCTION

Recent exploration and underground development of tin deposits in Billiton Metals Canada Inc.'s North Zone at Mount Pleasant has been carried out by Lac Minerals Ltd. ;(who are earning a 50 % interest in the project). This work has outlined at least three distinct phases of granite designated Granite I, Granite II and Granite III. Some of these phases may be correlative with phases in the Fire Tower Zone previously defined by Kooiman et al. (1986). The nature of the various granitic phases and their relationship to tungsten-molybdenum and tin deposits is the subject of continuing research by the first author. This paper summarizes the geological setting of the Mount Pleasant intrusions and associated tin deposits in the North Zone, incorporating the results of recent exploration and re-examination of core drilled in the 1960s and 1970s by previous operators.

GENERAL GEOLOGY

Granitic intrusions and associated deposits at Mount Pleasant were emplaced in Late Devonian or Early Carboniferous time along the southwestern margin of the Mount Pleasant caldera (Fig. 1). They have intruded intracaldera volcanic and sedimentary rocks of the Piskahegan Group, recently dated as Late Devonian (McCutcheon, 1986). At Mount Pleasant, the Piskahegan Group consists of at least three felsic ash-flow tuff units, a felsic to intermediate flow and two conformable interlayers of sedimentary breccia. In the Mount Pleasant area, the Piskahegan Group rocks generally dip about 10 to 15° to the northwest except along the margin of the caldera where they dip at 15 to 50° toward the centre of the caldera. They are bounded to the west by slate and greywacke of the Silurian Waweig Formation which form the southwest boundary of the Mount Pleasant caldera. At least



DEVONIAN AND/OR MISSISSIPPIAN
NORTH ZONE

- GRIII — Granite III
- GRII — Granite II
- GRI — Granite I
- NZBx — North Zone breccia

FIRE TOWER ZONE

- PG — Porphyritic granite
- GP — Granite porphyry
- FG — Fine grained granite
- FTBx — Fire Tower breccia

LATE DEVONIAN
PISKAHEGAN GROUP

- FP — Feldspar porphyry
- QFP — Quartz - feldspar porphyry
- SBx — Sedimentary breccia

SILURIAN

- W — Waweig Formation: slate and greywacke

Geological boundary (defined, approximate, gradational)
Fault (defined, approximate)
Diamond - drill hole (vertical, inclined, on section, extrapolated to section)
Adit or decline
Mineralized zone
All weather road
Bush road

Figure 1. Surface geological map of the Mount Pleasant area (modified from Ruitenberg, 1967 and McCutcheon, 1983).

two sets of faults are present. One set trends 070° and includes the Fire Tower fault (Fig. 1). Another set trending approximately northwest is prominent in the North Zone but is not well documented.

Quartz-feldspar porphyry

The three ash-flow units now recognized at Mount Pleasant have been referred to collectively in the past as "quartz-feldspar porphyry" (e.g. Ruitenberg, 1967; Parrish and Tully, 1978; Kooiman et al., 1986). The three units are all similar in appearance and consist of rhyolitic crystal tuff characterized by medium-grained phenocrysts of quartz (15 to 25 % by volume) and pink and white feldspar (10 to 30 %) in a light-grey, microcrystalline matrix. The central parts of the flows are typically massive and structureless; eutaxitic foliation is present in places near the upper and loweer contacts of the flows. Fragments of slate or argillite up to several centimetres across occur locally in the flows near their lower contacts. Where no eutaxitic foliation is present, quartz-feldspar porphyry resembles an intrusive rock and intrusive phases may be present, particularly in the Fire Tower Zone (Kooiman et al., 1986). The quartz-feldspar porphyry exposed at surface is equivalent to McCutcheon's (1983) Little Mount Pleasant Tuff unit which occurs to the east of Mount Pleasant.

Feldspar porphyry

"Feldspar porphyry" is a rhyodacitic unit with abundant mdium- to coarse-grained pink feldspar phenocrysts (20 to 30 % by volume) and minor fine- to medium-grained quartz phenocrysts (less than 5 %) in a brown to grey microcrystalline matrix. The phenocrysts are subhedral to euhedral and unbroken; they do noto exhibit fragmentation characteristic of a tuffaceous origin. Feldspar porphyry is also relatively massive with no obvious primary layering. It appears to overlie quartz-feldspar porphyry conformably but the contact in the vicinity of the North Zone has been obscured by alteration and appears gradational. This unit is thus extrusive and is probably a lava flow rather than a crystal tuff. It is equivalent to the intrusive Feldspar Porphyry unit of McCutcheon (1983).

Sedimentary breccia

The two sedimentary breccia units consist mainly of angular to subrounded, clast-supported fragments of slate or argillite in a fine-grained matrix of similar material. Quartz fragments make up less than 10 % of the breccia and fragments of quartz-feldspar porphyry are rare. All the fragments are unsorted and typically range from 1 to 5 cm across. The sedimentary breccias are relatively massive with little internal structure; thin beds of fine-grained material that show sedimentary layering are rare. However, textural features are generally indistinct because the sedimentary breccias have been metamorphosed to biotite hornfels by the underlying granitic intrusions.

The distribution of sedimentary breccias at Mount Pleasant is shown in Figures 2 and 3. They appear to be conformable layers that separate the three ash flow units of quartz-feldspar porphyry. The uppermost breccia unit is at least 50 m thick along the margin of the caldera and pinches out to the east (Fig. 3). It has been traced for a short distance south of the Fire Tower fault where it either pinches out or is truncated by granitic dykes or croscutting breccias (Fig. 2). The lowermost unit is as much as 25 m thick near the caldera margin and pinches out to the south. It likely pinches out to the east also but its distribution in this direction is not well known.

The sedimentary breccia is lithologically similar to much of the sedimentary breccia or "sharpstone conglomerate" in McCutcheon's (1983) Scoullar Mountain Formation, which occurs at various localities around the margin of the Mount Pleasant caldera. The sharpstone conglomerate consists

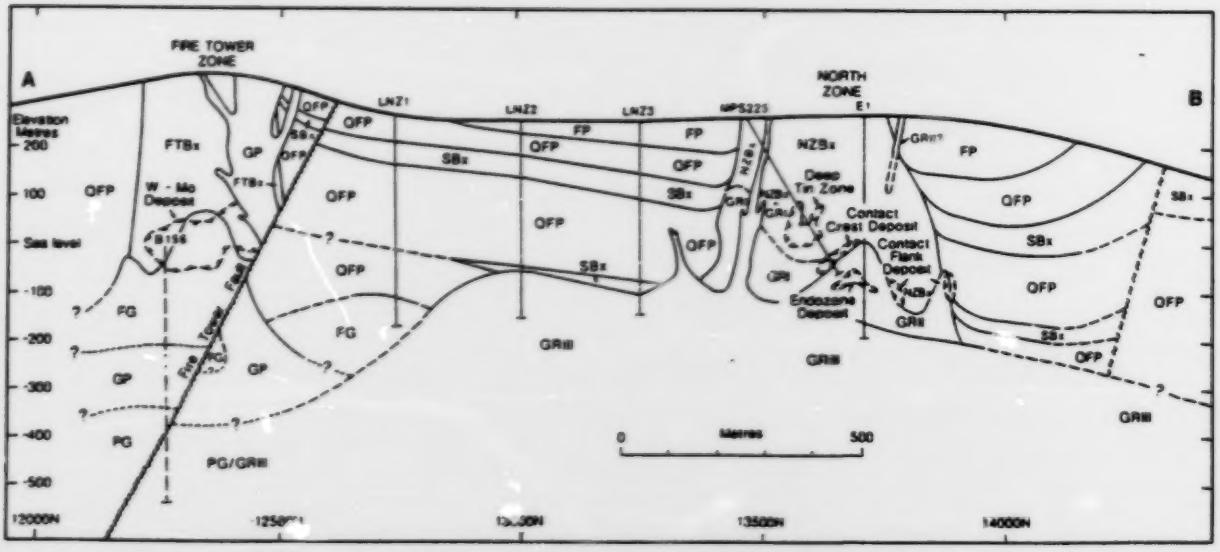


Figure 2. Cross-section A-B (Fig. 1) through the Mount Pleasant area (see Figure 1 for legend).

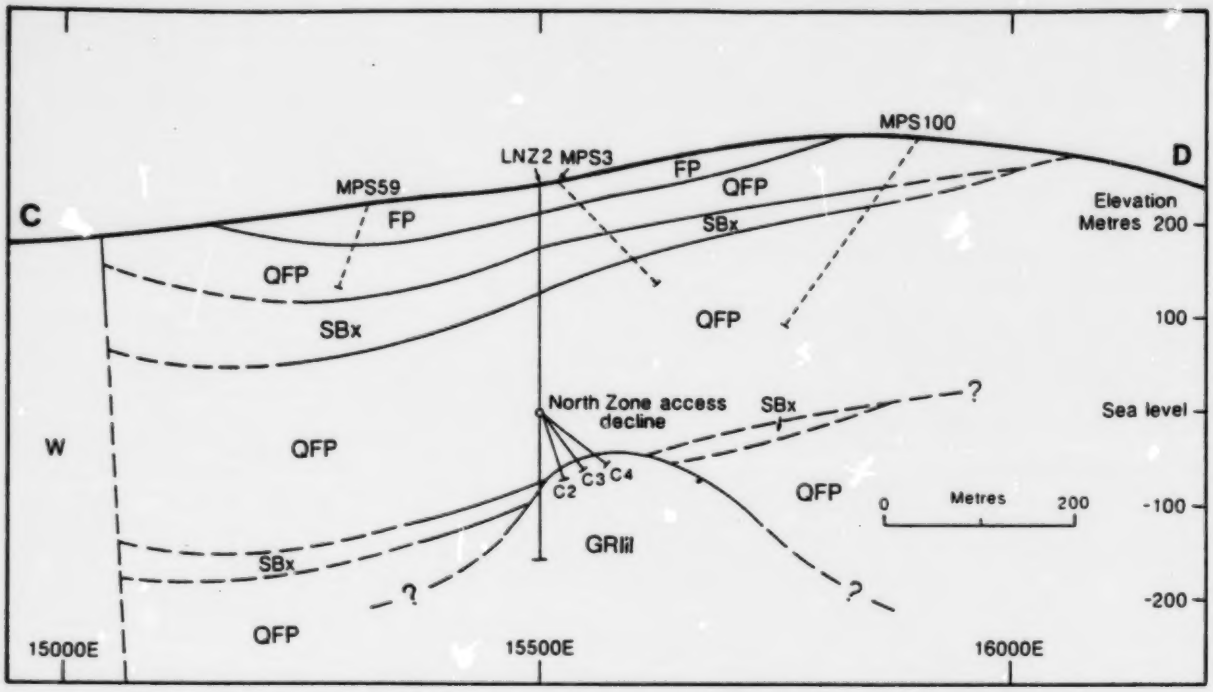


Figure 3. Cross-section C-D (Fig. 1) through the Mount Pleasant area (see Figure 1 for legend).

predominantly of angular, unsorted, clast-supported fragments of metasedimentary rock in a comminuted matrix of the same material. Fragments of felsic crystal tuff and, in places, granite are lss abundant. Internal layering with a water-w ked matrix is rare. The conglomerate is interbedded with mafic to intermediate lavas and pyroclastic rocks, and felsic tuffs. Which of the Scoullar Mountain sedimentary breccia units correlate with those at Mount Pleasant is uncertain. However, all the sedimentary beccia units represent talus and/or other types of colluvial deposits derived mainly from nearby metasedimentary and granitic rocks that formed the caldera walls during the initial infilling of the caldera. The volcanic fragments probably were contributed by a precaldera eruptive unit which has been eroded (McCutcheon, 1985).

North Zone breccia

The ash-flow tuffs and interbedded sedimentary breccias have been highly brecciated and intruded by granitic rocks in two areas designated the Fire Tower Zone and the North Zone (Fig. 1). In both these areas, crosscutting magmatic-hydrothermal breccias and intrusive rocks form irregular, pipelike complexes that were centres of subvolcanic intrusive and hydrothermal activity. Similar to the Fire Tower breccia as described by Kooiman et al. (1986), the North Zone breccia is composed of multiple phases which range from matrix-supported breccias with rounded fragments to clast-supported crackle breccias with predominantly angular fragments. Both fragments and matrix material in the breccias have been altered extensively. Siliceous alteration consisting of quartz and topaz is most prevalent; however chlorite and/or biotite alteration is also present. Because of the alteration, textures and lithologies of the fragments are difficult to recognize. Relationships between the breccia and associated granitic rocks have also been obscured by alteration in many places.

The North Zone breccia probably was formed by repeated episodes of hydraulic fracturing related to the release of volatiles during crystallization of Granite I. Forceful emplacement of the breccia is indicated by the deformation of older sedimentary breccia units which have steep to vertical dips adjacent to their contacts with North Zone breccia.

GRANITIC INTRUSIONS

Based on field observations, granitic rocks in the North Zone appear to have formed three distinct intrusions which, from oldest to youngest, are designated Granite I, Granite II and Granite III. The three granites, where relatively unaltered, are similar mineralogically and consist of quartz, K-feldspar, plagioclase and biotite (typically chloritized). Texturally, they range from aplitic to porphyritic and, in Granite III, to medium-grained equigranular. As they can all appear similar in hand specimen, distinction between the different granites is based to a large extent on mutual contact relationships. However, Granite I and Granite II are commonly fractured and highly altered and in many places contact relationships between these two intrusions are not obvious.

Granite I

Granit I occurs as irregular bodies closely associated with the North Zone breccias. Its contacts with the breccias are commonly gradational and fragments of Granite I are abundant locally within the breccias. In this regard it is analogous to fine-grained granite of the Fire Tower Zone. Granite I is typically fine grained and equigranular in relatively unaltered specimens. However, in most areas textural features of Granite I have been obscured by pervasive chloritic and/or silicic alteration. Porphyry tungsten-molybdenum deopsits in the North Zone appear to be related to Granite I.

Granite II

The main body of Granite II occurs at the base of the North Zone complex (Fig. 2). Dyke-like extensions of Granite II have intruded the overlying breccias and associated host rocks in places. Porphyry dykes that outcrop at surface may be related to Granite II.

Granite II varies from aplitic to porphyritic in texture. Parts of Granite II also contain features that reflect fluid saturation and/or undercooling of the parent magma, including miarolitic cavities and comb quartz layers. The combquartz layers consist of parallel to subparallel layers in which quartz crystals are oriented approximately perpendicular to the planes of layering (Fig. 4,5) (cf. Kirkham and Sinclair, in press). They are one of a family of unidirectional solidification textures (USTs) that are associated with fluid-saturated and/or undercooled magmas (cf. Shannon et al., 1982). Granite associated with the comb quartz layers commonly contains micrographic intergrowths of quartz and K-feldspar (Fig. 6), a feature that is also characteristic of undercooled granitic melts (Walker, 1976; Fenn, 1979).

Granite II consists of multiple phases which have internal contacts marked by chilled zones and USTs such as comb quartz layers. The distribution of USTs shown in Figure 7 appears to outline a small intrusive phase within Granite II. Figure 7 also shows an internal contact in diamond-drill hole C83 that is marked by aplitic layering. In general, these internal phases are either local or obscured by alteration and cannot be traced from one drillhole to another.

Tin deposits in the North Zone are associated mainly with Granite II. The Endozone, Contact Crest and Contact Flank deposits, for example, occur either within or at the contact of Granite II (Fig. 2). The Deep Tin Zone is also likely related to Granite II although not as closely associated spatially. Tin zones near surface in the North Zone (not shown in Fig. 2) are associated with porphyry dykes that may be offshoots of Granite II. Because of its relationship to tin deposits, Granite II is comparable to granite porphyry of the Fire Tower Zone, which is also associated with tin zones (Kooiman et al., 1986).

Granite III

Granite III forms a large body that underlies both the North and Fire Tower zones. In the North Zone, contact relationships show clearly that Granite III has intruded granites I and II. The contacts between Granite III and the other granites are commonly sharp and in many places are marked by thin (0.5 to 2 cm wide) layers of USTs, mainly K-feldspar, in Granite III. The upper contact of Granite III appears to have its apex west of the North Zone. Dykes of Granite III extend upward from the main body. Preliminary chemical data indicate that Granite III is identical to porphyritic granite of the Fire Tower Zone.

Figure 4. Comb quartz layers in granite porphyry from the Fire Tower Zone; quartz crystals in the layers terminate towards the right. GSC 204152-H

Figure 5. Photomicrograph (uncrossed nicols) of comb quartz layer in Granite II showing euhedral termination of quartz crystals approximately perpendicular to the layers; the very fine grained texture of the granite adjacent to the crystal faces probably resulted from pressure quenching related to the sudden release of the fluid phase in which the quartz crystals were growing. GSC 204152-T

Granite III is typically fine- to medium-grained equigranular although porphyritic and pegmatitic varieties are also present. Miarolitic cavities ranging from 1mm to 2 cm in size are locally abundant; in places they form 1 to 5 % by volume of the granite over several metres of drill core. The cavities are typically lined by quartz and feldspar crystals and filled by light green, very fine grained sericite (Fig. 8). Muscovite, chlorite, fluorite and carbonate are present in many cavities; arsenopyrite, molybdenite and other metallic minerals (unidentified) are rare.

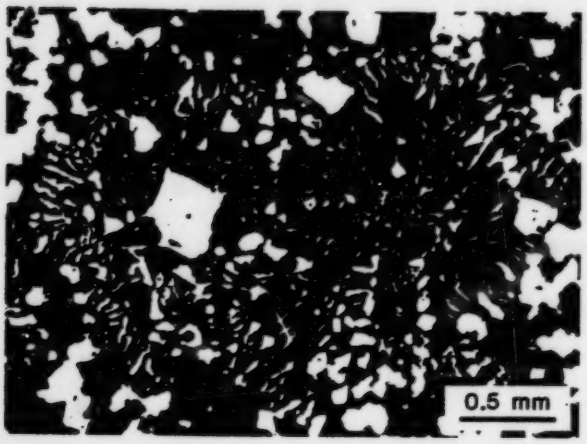


Figure 6. Photomicrograph (uncrossed nicols) of well-developed micrographic intergrowth of quartz (light) and K-feldspar (dark) in Granite II. GSC 204152-U

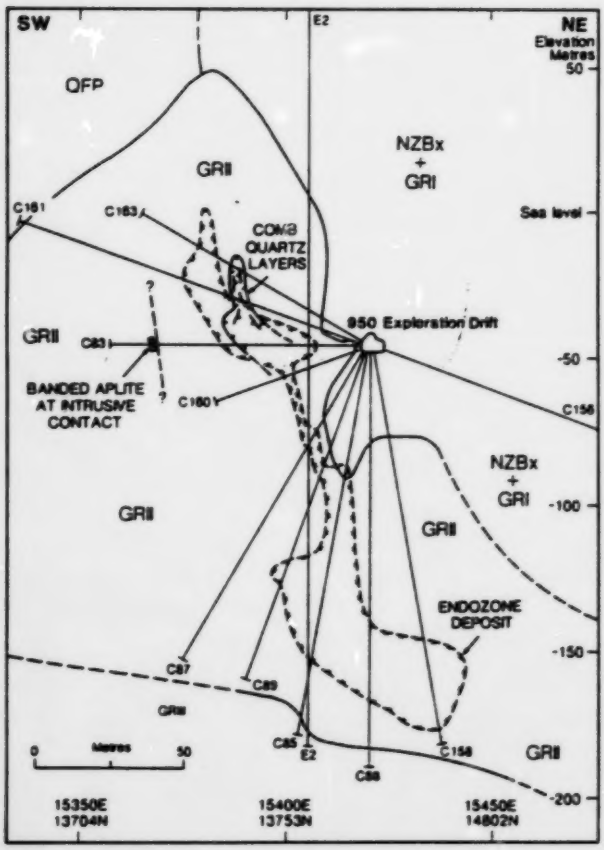


Figure 7. Cross-section (3A) through the Endozone deposit, North Zone (see Figure 1 for legend).

Granite III is generally less fractured and altered than Granite I and Granite II although some areas have been pervasively sericitized. Despite this sericitic alteration and fluid saturation textures such as the miarolitic cavities described above which are evidence of hydrothermal activity related to Granite III, only a few isolated tin zones have been found associated with it. However, exploration of Granite III to date has been too limited to assess fully its potential for associated deposits.

TIN DEPOSITS

Tin deposits and porphyry tungsten-molybdenum deposits in the North Zone represent two separate episodes of mineralization even though the deposits overlap spatially. Porphyry tungsten-molybdenum deposits resemble in many respects those in the Fire Tower Zone described by Kooiman et al. (1986). They consist of large zones of mineralized factures, quartz veinlets and disseminations in North Zone breccia and, to a lesser extent, Granite I. The host rocks have been altered to a very fine grained assemblage of quartz, topaz, fluorite and sericite. Wolframite, molybdenite, bismuth and bismuthinite are the principal ore minerals; abundant arsenopyrite and loellingite are also present. Total reserves in the porphyry tungsten-molybdenum deposits of the North Zone are approximately 11.5 million tonnes grading 0.20 % ;W, 0.06 % Mo and 0.09 % Bi.

Tin is distributed in the North Zone in a variety of deposits which span a wide vertical range. Near surface, numerous small, poorly-defined sulphide-rich replacement deposits occur in altered feldspar porphyry associated with aphanitic dykes referred to as "banded quartz-feldspar porphyry" by Ruitenberg (1967). These deposits have been

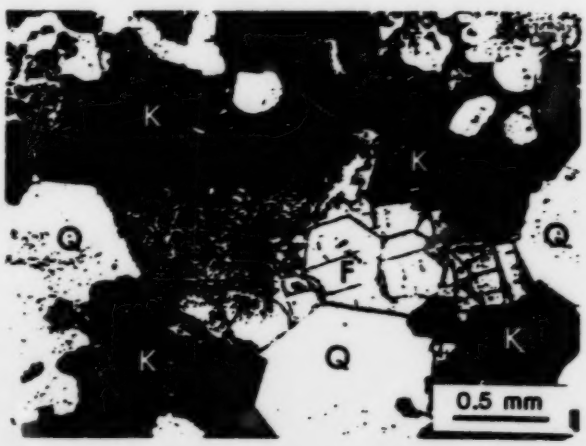


Figure 8. Photomicrograph (uncrossed nicols) of miarolitic cavity in Granite III lined with crystals of quartz (Q), K-feldspar (K), fluorite (F) and molybdenite (M) and filled with sericite (S). GSC 204152-V.

described by Ruitenberg (1963, 1967) and others (e.g. Hosking, 1963; Petruk, 1964). In these deposits, very fine grained cassiterite and lesser amounts of stannite are associated with arsenopyrite, loellingite, sphalerite and chalcopyrite. Other less abundants sulphides and sulpharsenides include pyrite, marcasite, galena, molybdenite, tennantite, bornite, bismuthinite, wittichenite and roquesite. Quartz, fluorite, topaz and chlorite are the principal alteration minerals. Proven reserves in these deposits are approximately 250,000 tonnes with an average grade of 0.6 % Sn, 2.3 % Zn, 0.30 % Cu and 0.36 % Pb (Mulligan, 1975).

Most of the potentially economic tin deposits in the North Zone occur at depths of 200 to 400 m below surfac. They include the Deep Tin Zone, Contact Crest, Contact Flank and Endozone deposits (Fig. 2). The Deep Tin Zone is a relatively large, irregular deposit that consists of fracture--controlled and disseminated cassiterite in silicified and chloritized North Zone breccia and Granite I. The cassiterite is fine grained but visible in hand specimens. Other associated minerals include arsenopyrite, sphalerite, chalcopyrite and galena. Some wolframite and molybdenite are also present, which may be due to the superposition of the Deep Tin Zone on one of the porphyry tungsten-molybdenum zones (not shown on Fig. 2). Reserves in the Deep Tin Zone are approximately 2.14 million tonnes grading 0.45 % Sn, 0.06 % W, 0.03 % ;Mo and 0.80 % Zn (0.45 % Sn represents a "cut" grade; intervals grading more than 2 % Sn have been cut to 2 %).

The Contact Crest and Contact Flank deposits occur mainly in North Zone breccia or other associated host rocks at the upper contact or along the sides of Granite II, respectively. The Endozone deposit, on the other hand, occurs mainly within Granite II. In many other respects, these deposits are similar. Cassiterite is the principal tin mineral and occurs as finely disseminated grains and as fine to medium-sized grains in veins or veinlets and along fractures. Minerals associated with the cassiterite include arsenopyrite, sphalerite, chalcopyrite, pyrite and pyrrhotite. Chlorite, fluorite, quartz and topaz are the main alteration minerals. Crosscutting relationships indicate as many as 6 stages of alteration and mineralization; details of the paragenesis of the Endozone, the largest of these deposits, is curently the subject of a Master's thesis study by C. Inverno (Colorado School of Mines). Total reserves in the Deep Tin Zone, Contact Crest, Contact Flank and Endozone deposits have been estimated at 5.9 million tonnes averaging ;0.79 % Sn (The Northern Miner, 14 October 1985, p. 11).

DISCUSSION

The Mount Pleasant intrusions were emplaced at the margin of the Mount Pleasant caldera in a subvolcanic environment. The present depth of the intrusions from surface (300 m or less) and the likelihood that no more than 600 to 700 m of overlying volcanic and sedimentary rocks have been removed by erosion suggest that the intrusions were emplaced at a depth of about 1 km or less.

The subvolcanic ;emplacement of the granitic intrusions has implications for the generation of the hydrothermal fluids that formed the ore deposits. In such a shallow environment of intrusion, involvements of both meteoric and magmatic fluids in the formation of the tin deposits might be expected. Preliminary data from a study of fluid inclusions (Samson, 1987) indicate that meteoric water may have been involved in at least one stage of tin mineralization. On the other hand, Granite II, which is most closely associated with the tin deposits, contains a number of features that suggest a significant portion of the ore-forming fluids were magmatic. The presence of miarolitic cavities and comb quartz layers in some phases of Granite II indicate that they were fluid-saturated. The same phases commonly contain micrographic intergrowths of quartz and K-fldspar. These textures reflect undercooled conditions in the magma which could have been due to pressure quenching caused by rapid separation of ore-bearing fluids. A genetic relationship between tin deposits and associated phases containing these features, such as the one outlined by the comb quartz layers on Figure 7, thus seems likely, Research currently in progress with B.E. ;Taylor (Geological Survey of Canada) to examine stable isotopes (O,H,C,S) of the granitic rocks and associated mineralized zones will provide insights to the nature of the ore-forming processes, including the relative importance of magmatic versus meteoric fluids.

Whether or not the Mount Pleasant intrusions are closely related to volcanic rocks within the Mount Pleasant caldera is uncertain as the age of the intrusions has not been completely resolved. K-Ar and Rb-Sr isotopic studies (Kooiman et al., 1986) indicated a Late Mississippian age of 340 to 330 Ma. On the other hand, $^{40}Ar/^{39}Ar$ data suggested a Late Devonian-Early Mississippian age of about 360 Ma (D.A. Archibald, pers. comm., 1985), essentially the same age as the Piskahegan Group rocks which the granites have intruded. More accurate and precise dating of the granitic rocks by U-Pb isotopic analysis of manozite is being considered to resolve this discrepancy. Rb-Sr isotopic studies of fluorite associated with the various granitic intrusions and associated deposits, currently underway with R.P. Taylor (Carleton University), may also contribute to a resolution of the age of the Mount Pleasant intrusions.

The Mount Pleasant intrusions have been classified as A-type granite (Taylor et al., 1985; Kooiman et al., 1986). Geochemical and petrographic work currently underway will help to characterize the intrusions at Mount Pleasant within a broader context of other granites in New Brunswick (e.g. Fyffe. et al., 1981; Ruitenberg and Fyffe, 1982; McLeod, 1986; Whalen, 1986).

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